TOBER 16, 1961
olume 50, No. 21

Contents—Page 7

OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

AMERICAN DYESTUFF REPORTER

TEXTILE WET-PROCESSING

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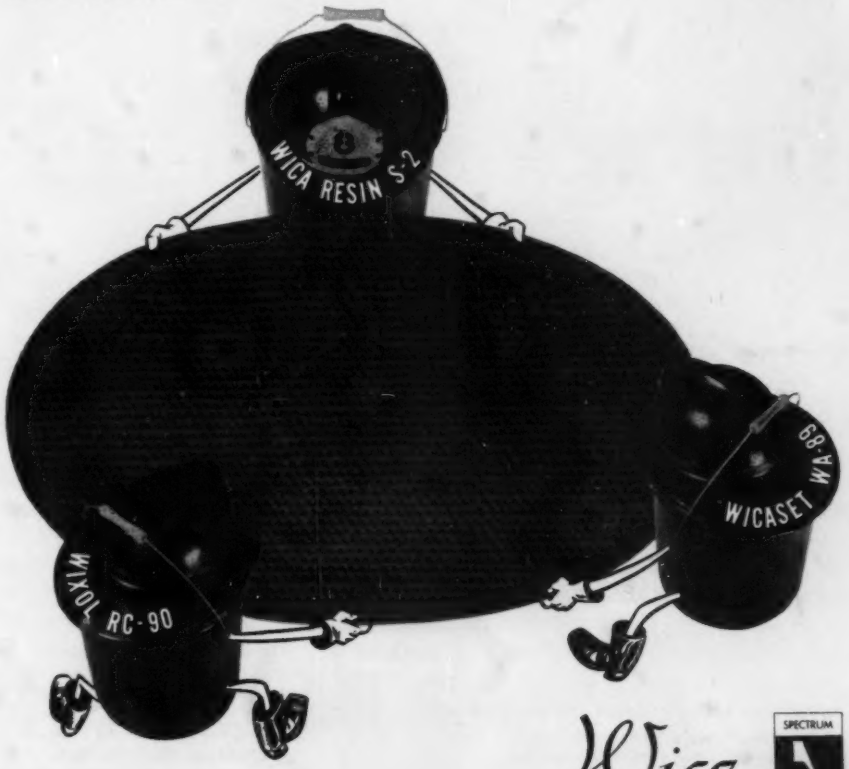
WIXOL RC-90 controls crocking and bleeding of fiber reactive dyed goods.



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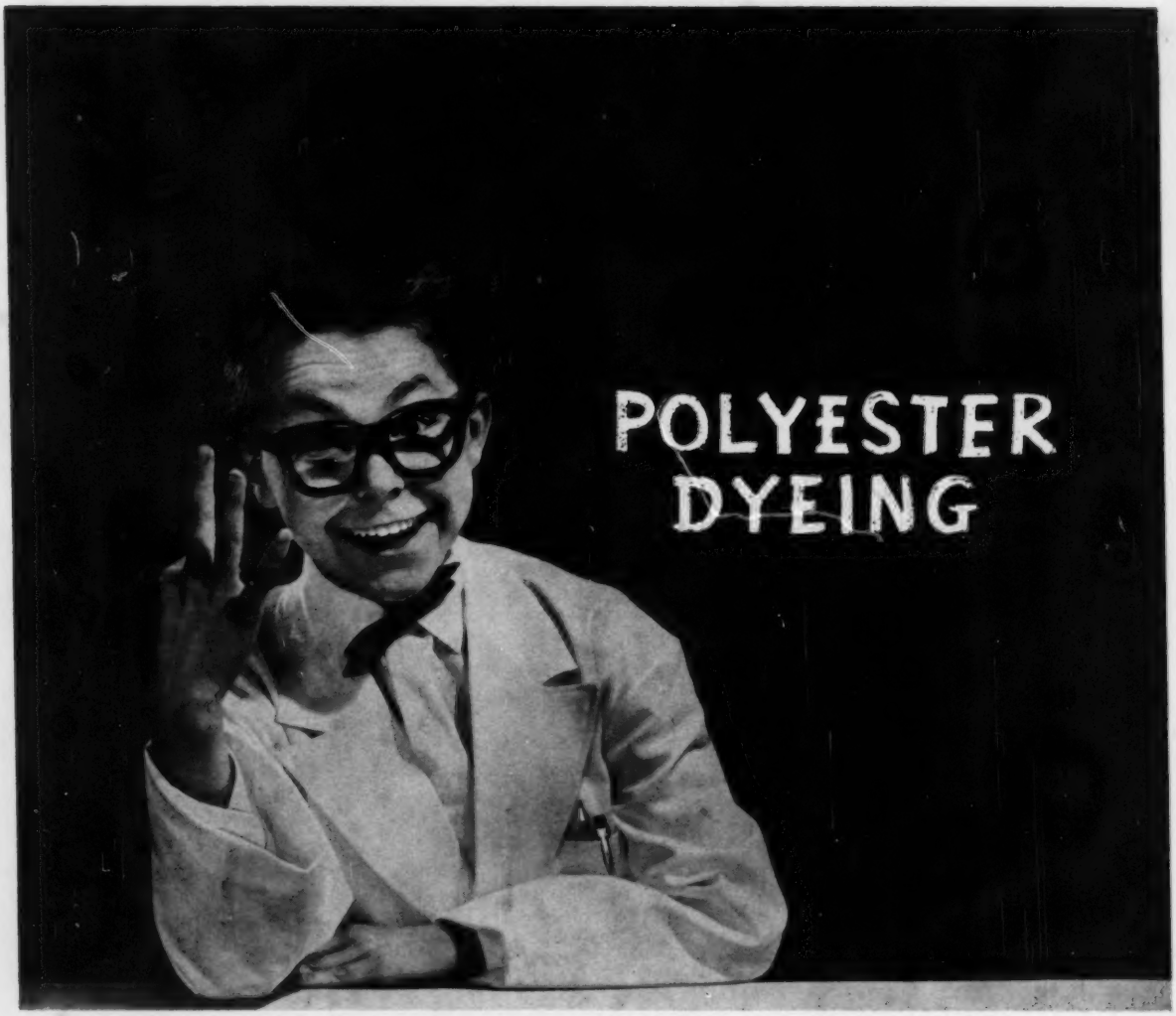

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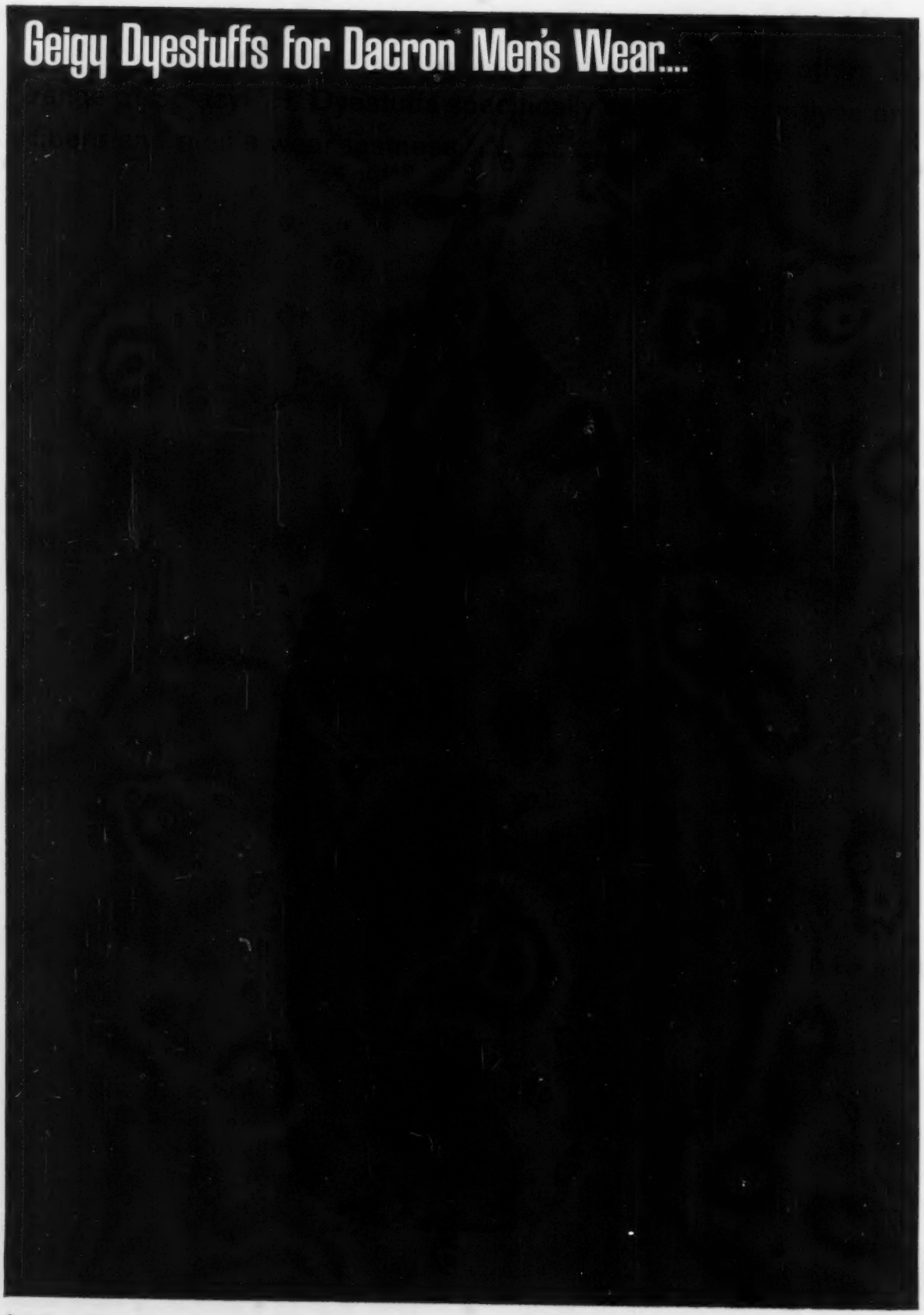
Dept. UF8 52-2, 40 Rector St., New York 6, N. Y.

Geigy Dyestuffs for Dacron* Men's Wear....



ESTABLISHED
1917

Including since 1921, the official Proceedings of the American Association of Textile Chemists and Colorists

AMERICAN DYESTUFF REPORTER

TEXTILE WET PROCESSING EXCLUSIVELY

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OFFICIAL
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OF
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AND
COLORISTS

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VOLUME 50 October 16, 1961 NUMBER 21

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J J Gaido and H D Terhune
Preparation and Properties of Fibrous Partial Isobutyrates of Cellulose 27 (796)
Hubert H St Mard, Crl Hamalainen, and Albert S Cooper Jr

aatcc proceedings

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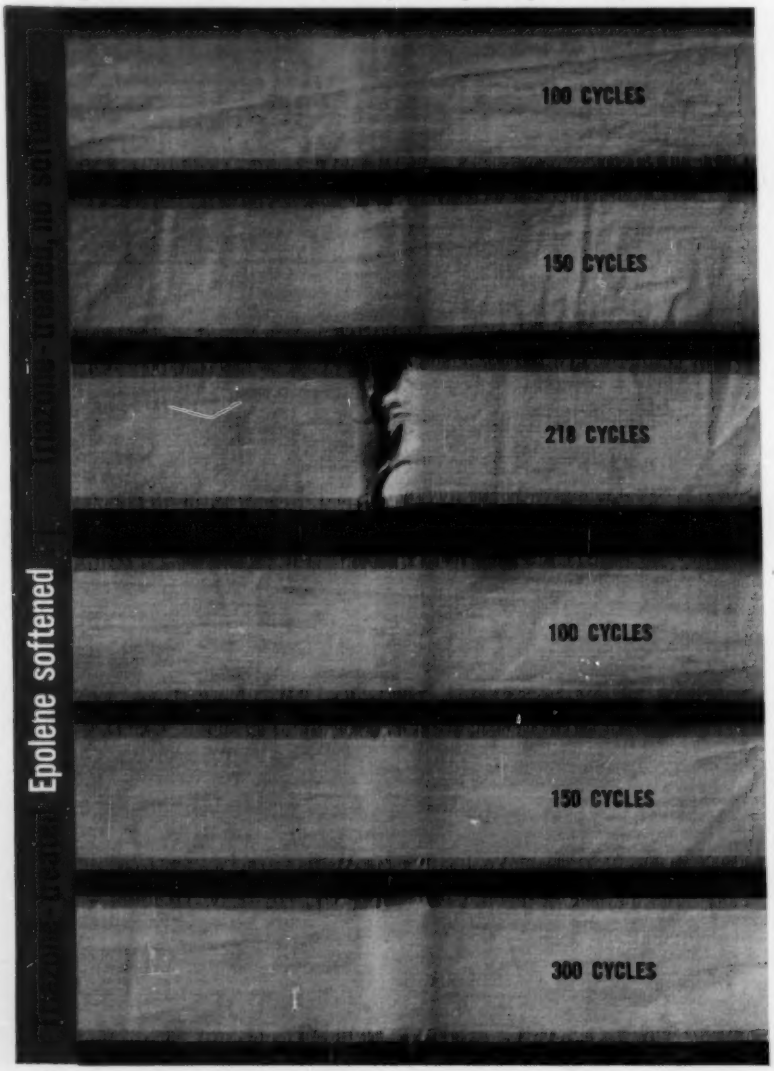
The Stoll-Flex Abrasion Test demonstrates the increased strength given to a resin-treated cotton fabric by an Epolene softener.

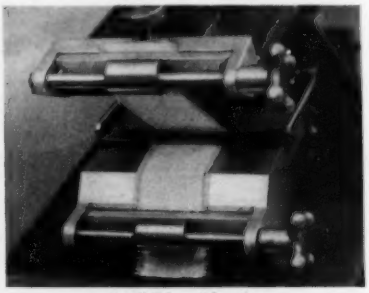


IT is axiomatic in the textile industry that the finishing resin alone does not a wash-and-wear fabric make. In fact, the variables are many, and often complex.

Of primary importance is selection of the softener. If properly chosen to match the specific type of finishing resin to be used, the combination can provide the optimum in tear strength, abrasion resistance, crease recovery, hand, and sewability for the treated fabrics.

Eastman offers three emulsifiable types of polyethylene resins for use as softeners... Epolene E-10, Epolene E-11, and Epolene E-12. These low-molecular-weight polyethylenes are suitable for either nonionic, anionic, or cationic systems, easily forming emulsions that are stable and low in color.

Epolene polyethylene emulsions have been evaluated under operating conditions with all of the principal wash-and-



Stoll-Flex Abrader

wear resins in use today. These include triazone, triazene, melamine formaldehyde, methylated melamine formaldehyde, dimethylol ethylene urea, and methylated urea-formaldehyde type finishing resins. The results of these test procedures are available to aid you in selecting the right softener for your finishing requirements.

For further information about Epolene textile emulsions, their preparation and use, contact your Eastman representative, or write Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company, Kingsport, Tenn.

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OPEN FORUM

(A page devoted to reader comments, general comments by the staff of *American Dyestuff Reporter*, and "letters to the editor". Names of those submitting material for this page will be withheld on request. Address letters to "Open Forum," American Dyestuff Reporter, 44 East 23rd St, New York 10, N. Y.

October 16, 1961

ON April 3, 1961, the publishers of *American Dyestuff Reporter* initiated this page, which is designed to bring to its readers an additional editorial service—an editorial page, a place for comment, suggestion and opinion.

Verbal comments from many of our readers have been enthusiastic and indicate that it is being well received. However, a number of readers have stated that they "discovered" the page only recently and have suggested that perhaps we should once again outline the ideas behind its establishment. Others have suggested that we carry a "standing invitation" under the title, so as to continuously encourage readers to submit their views for publication. Still others have criticized the location of the page, contending that it does not "stand out" and is difficult to find. We appreciate any and all comments, pro or con, for it is our sincere desire to make the page of greatest service to our readers. And it is perhaps our greatest desire to make the page "by and for" the reader. Anonymity will, of course, be respected if material submitted is of a controversial nature, and the person submitting it desires anonymity; however, we must reserve the right to withhold publication of certain material if the source is anonymous.

The"Open Forum" began with a statement that "the publishers of *American Dyestuff Reporter* believe there is a need for—and good use can be made of—a platform for an expresion of ideas and thought about the many facets of our particular business, in the areas that precede, impinge upon or follow the specific area we are all concerned with, wet-processing technical knowledge, as well as in that area itself."

It went on to suggest that "the content of a technical paper does not begin nor end in a vacuum. What sociological, scientific, economic or political development helped to bring it into being? And what could be its potential impact on a specific operation, or on group business health, at the supplying or consuming levels? How are the processes of our industry affected by change and development in allied industries, by shifts in governmental attitude and action, by foreign development? How is our industry affected by its own actions, or inaction, by its own organizations? If progress, on any given matter, is aided by preliminary examination, current evaluation, and reflective judgment, then there is in our industry a useful place for a forum designed to yield enlightening discussion.

"Though much of the material appearing here will be prepared by the staff of the *American Dyestuff Reporter*, a great deal of it will arise from you, the reader. We must sincerely invite—urge—you to let us know your viewpoint on any question you are concerned with, or concerned about. Sometimes, we shall take the initiative and be in contact with you, to secure the benefit of your thinking. On some subjects regarding which opinion may be strong both for and against the issues, it is our purpose to present both sides of the question. Together—reader and publisher—we can strive to bring into clearer focus some of the questions that continually arise in our industry, including those to which an answer cannot be found in a technical paper.

"The expression of your views is most cordially invited."

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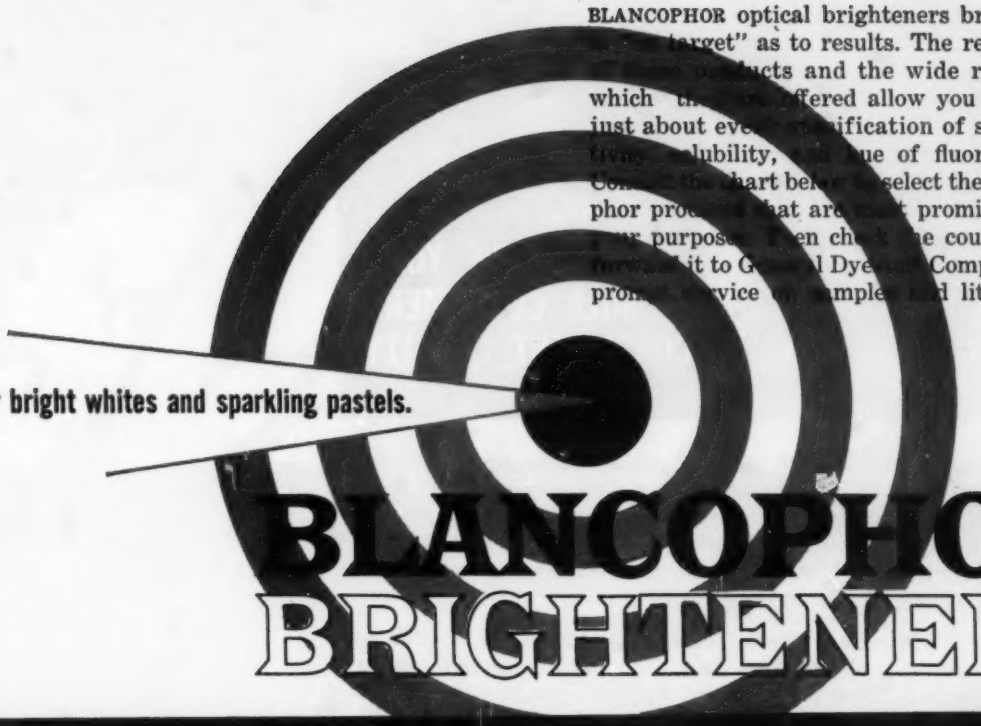

BLANCOPHOR optical brighteners bring you [illegible] target" as to results. The reliability [illegible] products and the wide range in which [illegible] offered allow you to meet just about eve[illegible]ification of substantivity, solubility, [illegible]ue of fluorescence. Consult the chart below to select the Blancophor products that are most promising for your purposes. Then check the coupon and forward it to General Dyestuff Company for prompt service on samples and literature.

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CB-32 (liquid)	+		15%	1	70-130°F	Moderate	Excellent
FFG (powder)		+	1%	5	130°F*	Fast	Good
GS-33 (liquid)	+		15%	3	70-130°F	Moderate to Fast	Very Good
HS-31 (liquid)	+		15%	4	70-130°F	Moderate	Excellent
HS-71 (powder)	+		15%	4	70-130°F	Moderate	Excellent
MS-31 (liquid)	+		10%	2	70-130°F	Fast	Good
MS-72 (powder)	+		10%	2	70-130°F	Fast	Good

*Acrylics require a dyeing temperature of 180-200°F.

gdc gaf

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For dye leveling...
cotton mercerizing...
any surfactant application
in the wet processing
of textiles

Atlantic Ultrawets

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The wide diversification in both mill products and their processing often presents problems to the textile manufacturer. One major problem of the mill is finding a surface active agent or balanced formulation with the best performance qualities for wetting, dye penetration or leveling and detergent properties. Formulations containing Atlantic Ultrawets can solve such problems.

Atlantic Ultrawets are top-quality alkyl aryl sulfonates characterized by excellent solubility and exceptionally low unsulfonated oil content. Ultrawets provide superior cleaning and wetting properties. In concentrations as low as 0.2% active, they will remove animal grease quickly and efficiently. In concentrations as low as 0.05% active, they can speed wetting and dye penetration.

Atlantic Ultrawets in formulations work effectively in cotton and wool scouring, soaping off and dye leveling. They work well in both hard and soft water. Stubborn stains and streaking problems disappear. Scouring is possible at lower temperatures. The Ultrawets are produced in an ideal range of molecular weights tailored to meet specific industrial applications. They are available in liquid and solid forms, bulk or drum quantities.

Atlantic's sales engineers are graduate chemists or chemical engineers. They are ready to help textile chemical supply houses recommend the proper formulation for a customer's particular need. Put their technical skills and know-how to work for you—without obligation—by writing Chemicals Division, The Atlantic Refining Company, 260 South Broad St., Philadelphia 1, Pennsylvania

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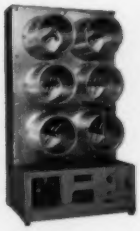

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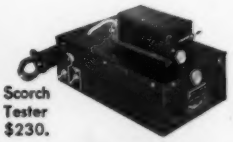

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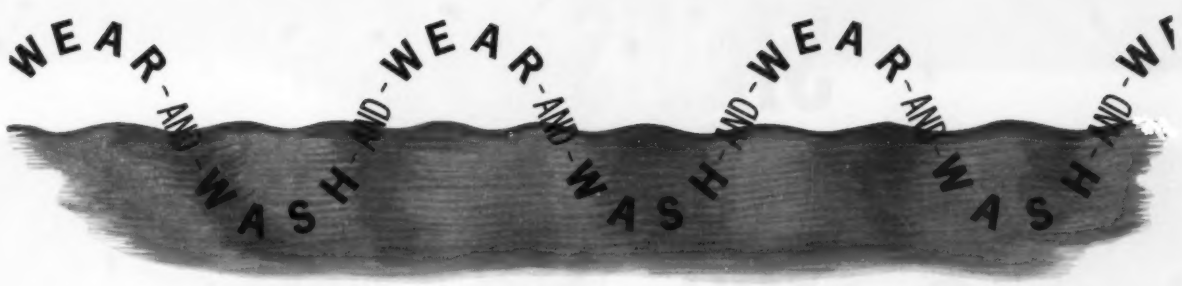

Thanks to AHCOVEL NW*
the new unique reactant softener

Finishes can now be produced which withstand laundering over and over again — and stay soft!

Ahcovel NW, a new and vitally important contribution to wash and wear finishing, enables resin treated cellulosics to be laundered again and again, while maintaining their softness and suppleness.

Fabric tear strengths are increased – and remain high!

Wrinkle recovery values are improved – and they last!

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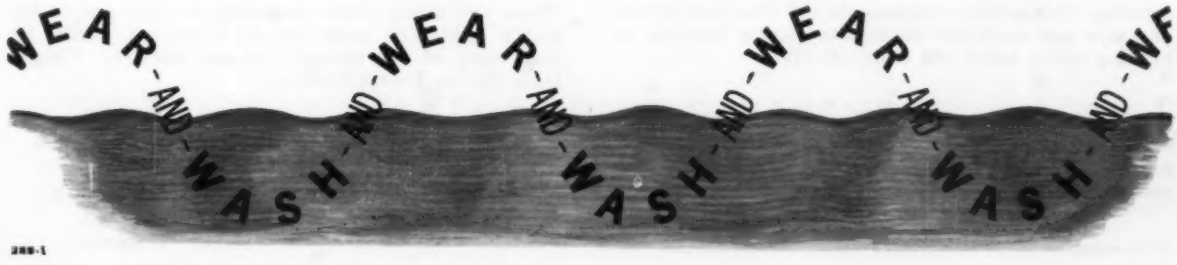

288-I

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Among the many ways in which Calgon can lend a hand in textile processing, the prevention of costly stains pays off in immediate results. Calgon helps prevent and clean up stains in these three ways:

1. Calgon softens water — prevents lime soaps from forming. Calgon also supplements the detergent action of soaps and synthetic detergents, makes removal of existing stains easier and more effective.

2. Calgon in the dyebath prevents precipitation, and resulting stains. It reduces scum, has a dispersive and solubilizing action on dyestuffs, acts as a leveling and penetrating agent.

3. Threshold Treatment with Calgon* eliminates troubles from both dissolved iron and iron picked up from pipes. Economical because of the small amounts used, Calgon treatment is the most efficient way of preventing the contamination of process water with corrosion products.

These and many other uses make Calgon one of the textile industry's most helpful chemicals. Write for your copy of the recently revised booklet, "Calgon Data for the Textile Chemist."

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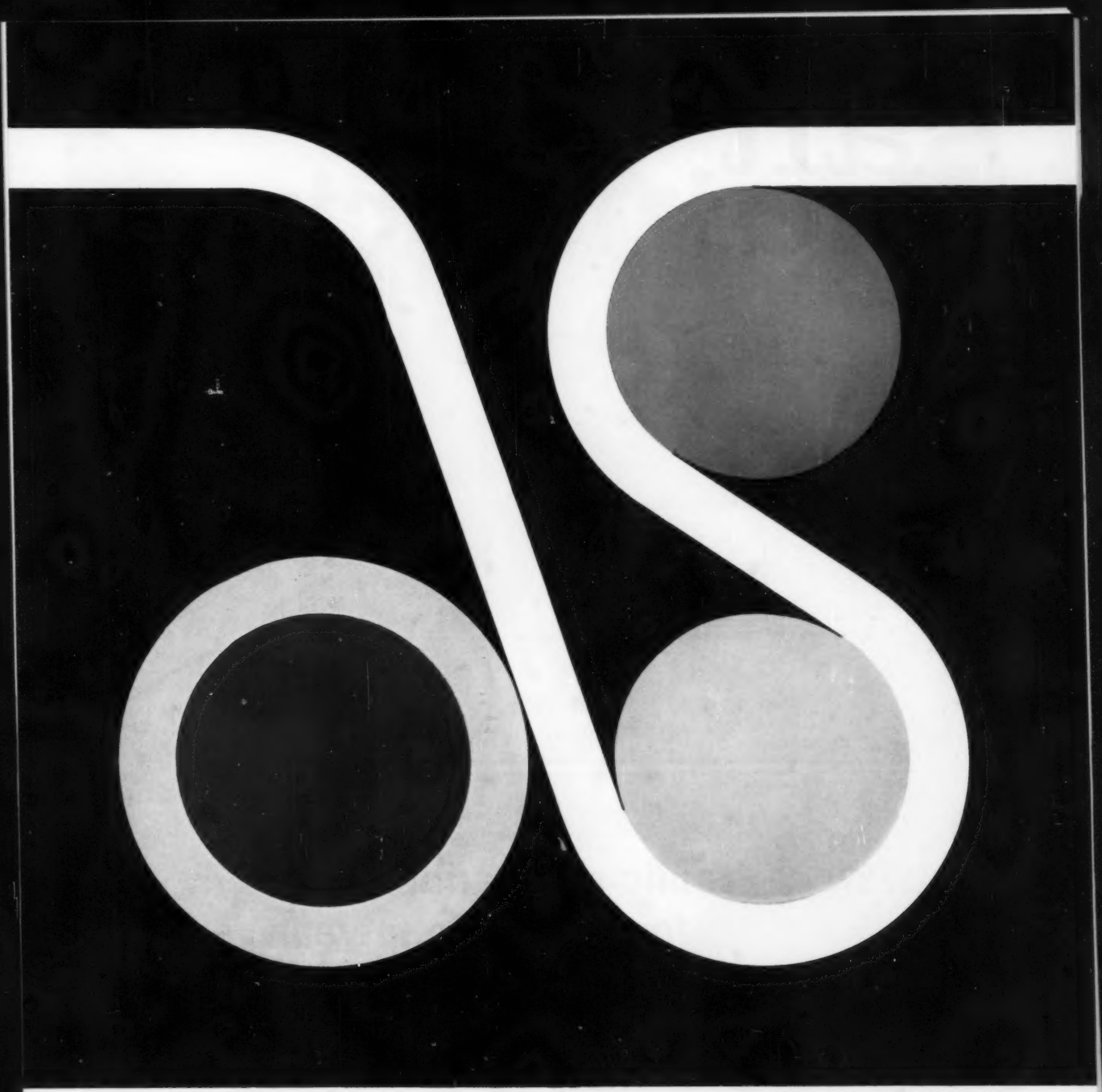

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TEXTILE COLOR DEPARTMENT

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DIVISION

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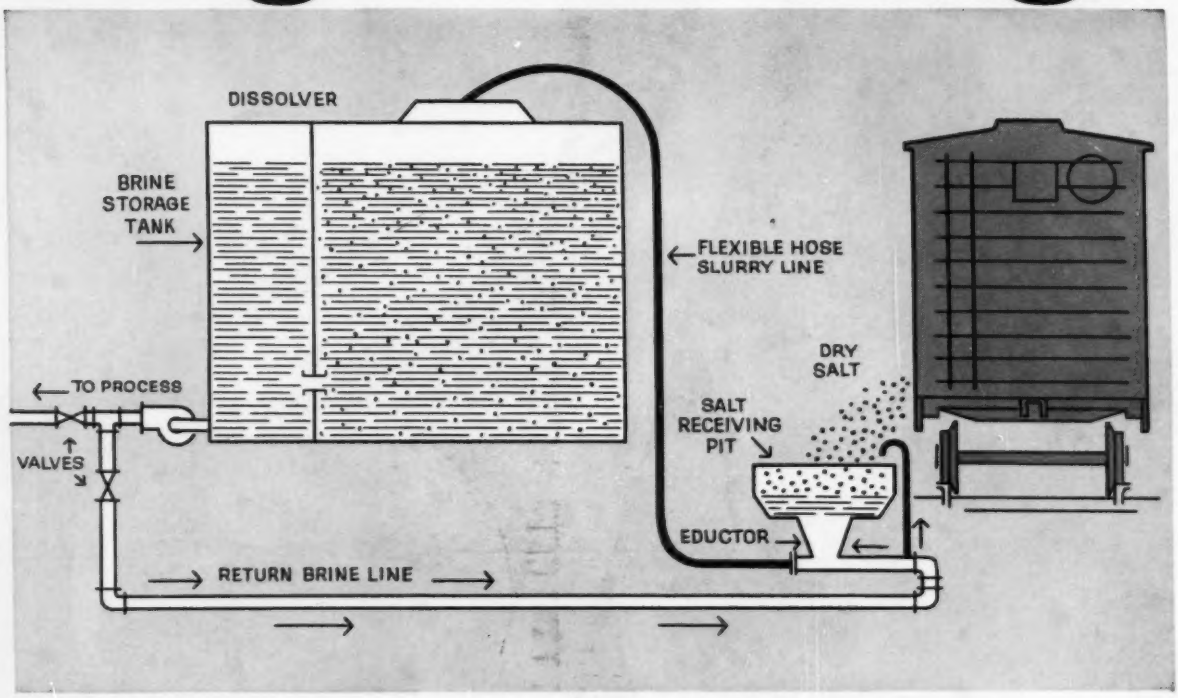
salt engineering



New hydraulic salt-handling system pays for itself in one year

A food-specialties manufacturer used to buy evaporated salt in bags. They used a batch mixing process to combine the salt with other ingredients to produce a patented product. Lugging the salt from boxcar to the plant, storing it, then dumping into mixing vats was time-consuming, expensive and took up valuable warehouse space.

In an effort to speed up and economize on the operation, this manufacturer called in an International Salt Company Technical Service Representative. He recommended simplifying the mixing process by installing a Storage Brinomat* Dissolver outside the plant. The Dissolver automatically supplies sparkling, pure brine to the process *continuously*.

He also recommended buying less expensive bulk salt by the carload and delivering it to the Dissolver by a hydraulic handling system. In this system, designed by International's Technical Service Department (see diagram above), a power scoop pushes salt from the cars into a receiving hopper feeding an eductor system. There the salt is mixed with brine from the Dissolver and educted as a slurry of saturated brine and undissolved salt to the Dissolver.

Efficiency and economy have been remarkable. After one year of operation the plant manager informed International that the entire system had already paid for itself!

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EVALUATION OF VARIABLES IN THE PRESSURE-KIER BLEACHING OF COTTON

J J GAIDO and H D TERHUNE

Electrochemicals Dept

E I du Pont de Nemours & Co, Inc

Wilmington 98, Delaware

Field trials have shown that it is practical to reduce the time required for the kier bleaching of cotton with hydrogen peroxide by using steam pressure to obtain faster, higher-temperature bleaching. A statistically designed set of 35 laboratory experiments was used to define the optimum operating conditions for a single-stage pressure-kier bleaching process. Computer analysis of the laboratory data showed that these higher temperatures (220°-250°F) accelerated bleaching with no adverse effect on fabric whiteness or fluidity. These properties were found to be dependent on bleaching time, alkalinity, and peroxide concentration. Absorbency was satisfactory in all samples bleached to an acceptable whiteness. Statistically devised graphs show that direct relationship between operating variables of the process and bleaching results. These graphs illustrate the direction of alteration of the variables, relative to each other, used (or required) to achieve a specific fabric property. This provides an effective tool when planning a mill operation. Dyeability tests showed that fabrics pressure-bleached to a high whiteness with good absorbency could be dyed satisfactorily. Increasing the alkalinity of the bleach was found to increase the depth of color obtained after dyeing.

INTRODUCTION

THE bulk of the woven and knitted cotton fabric produced in the United States is bleached by continuous processing methods. Many mills, however, prefer batch bleaching methods for handling light-weight, low-count fabrics which must be handled in slack form to avoid distortion. Certain tight-woven, heavy-weight fabrics made with high-twist yarns which are susceptible to damage from abrasion are also generally batch bleached. For large-volume production, these fabrics are usually bleached in kiers.

The principal disadvantage of kier bleaching is the low productive efficiency as compared with continuous bleaching processes. A complete kier-bleaching cycle, including loading and unloading time in addition to bleaching time, is frequently fifteen hours or longer; consequently, most mills operate on a one batch/day/kier basis, thereby losing 35% or more of the production capacity of their equipment. Preliminary field trials confirm that it is practical to reduce the time required for the kier bleaching cycle to less than 12 hours by using steam pressure to obtain faster, higher-temperature bleaching. Kier production was increased by 100% on the basis of two kier loads/day. Bleaching results were equal in every respect to the results produced by the longer operating cycle.

The pressure bleaching process is readily and safely adaptable for many mills because most kiers are designed for pressure operation. To assist in this adaptation, the program described below was undertaken to investigate the effects of variables in pressure kier bleaching and to define optimum operating conditions. To study simultaneously the effects on bleaching of four process variables—time, temperature, and NaOH and H_2O_2 concentrations—a statistically designed set of experiments was carried out. The purpose of this report is to describe the statistical method used to evaluate this process and the results obtained.

EXPERIMENTAL DETAILS

The statistical program used in this study was a four-factor, two-level factorial design with center and axial points. Based on previous laboratory and field experience, the following limits were established for the bleaching trials in this study:

Temperature	220° to 250°F
Time	10 to 180 minutes
Albone hydrogen peroxide concentration (as 35% H_2O_2)	2.0% to 4.0% (based on weight of fabric)
NaOH concentration	0.0% to 0.8% (based on weight of fabric)

Thirty-five combinations of the variables, within the above limits, were used in laboratory pressure-kier bleaching trials. These combinations of variables were designed to provide comprehensive data for computer analysis.

Bleaching trials were run in a one-pound-package dye machine modified to simulate a pressure kier. The central liquir distribution pipe of the package-dyeing unit was covered with a sleeve for two thirds of its height to bring the liquor to the top of the fabric pile. A deflector was used to spray the liquor over the fabric. A stainless-steel screen was placed on the bottom of the unit to support the fabric pile and provide good drainage. Heat was supplied by introducing steam into the jacket of the machine; it was controlled by a temperature regulator.

Because the results of the laboratory bleaching trials were to be analyzed statistically, all variables other than those under study had to be closely controlled. Size of the fabric samples, liquor-to-goods ratio, and warm-up time were kept constant.

The cotton fabric used in these experimental trials was 80 × 80 count, 3.7 yd/lb grey goods. An enzyme desize was the only pretreatment given the fabric. Fabric samples weighing 500 grams were cut into nine-inch strips, wet-out with distilled water, and hand piled into the kier in rope form. The cloth pile was compressed to the same depth in the kier for each trial. Preliminary tests showed that this loading procedure resulted in even bleaching throughout the fabric sample.

A liquor-to-goods ratio of 5:1 was used in these runs. The bleach liquors were prepared with distilled water. In addition to the quantities of H_2O_2 and NaOH established for each trial, the liquors contained 2.5% sodium silicate and 0.2% Versenex 80, based on the fabric weight.

The bleach liquors were circulated through the fabric pile in the kier for 10 minutes at room temperature. The kier was then closed and steam introduced into the jacket. A half-hour warm-up period was used in each of the bleaching trials. During this period, pressure resulting from air expansion was periodically relieved through a release valve. At 212°F, the kier was sealed. The temperature regulator permitted the temperature to rise to the designated bleach-trial temperature and then held this condition for the specified duration of the bleach. At the completion of the bleaching operation, the kier was gradually cooled and opened at 130°F. The bleached fabric was removed, rinsed several times, and dried.

The results of the laboratory pressure-kier bleaching trials were determined by measuring the following fabric properties:

1) Whiteness—These values were obtained by measuring the blue reflectance of the cloth with a Hunter reflectometer.
2) Fluidity—AATCC tentative test method 82-1954, *AATCC Tech Manual 36*, p 120 (1960), was used.
3) Absorbency—The standard AATCC drop test was used to measure this fabric property.

Dyeability tests on the pressure-bleached fabric samples were conducted by padding with 30 g/l CI Vat Blue 6 (CI 69825), drying, and developing in a steamer. Dyeability was evaluated by a visual comparison of the strength or depth of color of the dyed fabrics.

The enzyme-extractables and "fats, oils, and waxes" contents of the bleached fabric samples were determined by standard analytical procedures. The electrolyte content was obtained by heating weighed fabric samples in distilled water for two hours at 180°F. The conductivity of this solution was then measured by a Barnstead purity meter and recorded as % NaCl.

DISCUSSION

Table I lists the 35 laboratory pressure bleaching trials and their results. Examination of the whiteness, absorbency and fluidity values which were obtained indicates that results were satisfactory over a wide range of bleaching conditions. Whiteness of 87% to 88% was obtained without fabric degradation, none of the fluidities being higher than 2.6 rhes. In every case where a high level of whiteness was obtained, the absorbency was two seconds or less. These results show that control of this process in mill operation should not be difficult. Mote removal was observed to be excellent in each trial.

TABLE I
Pressure-kier bleaching trials and resulting fabric properties

No.	Temp (°F)	Time (min)	H_2O_2* (%)	NaOH* (%)	Whiteness (%)	Absorbency (sec)	Fluidity (rhes)
1	247	20	3.4	0.5	88.2	1.2	1.8
2	247	40	3.6	0.2	88.3	1.8	1.5
3	247	40	2.4	0.4	88.0	1.6	1.5
4	247	20	2.6	0.1	84.0	5.6	1.2
5	238	30	3.4	0.5	88.4	2.0	1.8
6	238	15	3.6	0.2	84.6	4.7	1.2
7	238	15	2.4	0.4	85.2	1.5	1.4
8	238	30	2.6	0.1	84.3	3.0	0.9
9	232	120	3.4	0.5	89.4	1.2	2.2
10	232	60	3.6	0.2	86.9	3.6	1.5
11	232	60	2.4	0.4	87.7	1.7	1.5
12	232	120	2.6	0.1	87.0	1.7	1.5
13	223	45	3.4	0.5	87.9	2.2	1.6
14	223	90	3.6	0.2	87.9	2.5	1.5
15	223	90	2.4	0.4	87.7	1.8	1.4
16	223	45	2.6	0.1	82.2	27.0	0.9
17	250	20	3.0	0.3	86.9	1.0	1.4
18	220	180	3.0	0.3	88.5	1.1	1.5
19	245	80	3.0	0.3	88.8	1.0	1.2
20	225	44	3.0	0.3	86.3	1.4	1.2
21	235	60	4.0	0.4	89.0	0.7	1.6
22	235	60	2.0	0.2	86.1	1.2	1.3
23	235	60	2.8	0.6	88.4	0.6	1.8
24	235	60	3.2	0.0	85.8	1.5	1.1
25	235	30	3.0	0.3	85.7	2.3	1.3
26	235	30	3.0	0.3	86.7	2.0	1.5
27	235	60	3.0	0.3	88.4	1.8	1.5
28	235	60	3.0	0.3	88.3	1.9	1.7
29	235	60	3.0	0.3	88.3	0.8	1.6
30	235	60	3.0	0.3	87.9	1.3	1.6
31	235	30	3.0	0.3	86.4	1.4	1.4
32	247	20	3.4	0.8	87.4	2.4	2.0
33	247	40	3.4	0.5	87.8	2.4	2.1
34	247	40	3.4	0.5	88.7	1.5	2.3
35	247	80	3.4	0.5	89.6	1.1	2.6

* Bleach liquors contained 2.5% sodium silicate and 0.2% Versenex 80 in addition to the concentrations of H_2O_2 (as 35% H_2O_2) and NaOH designated above.
Concentrations are based on fabric weight.

In the statistical evaluation, a digital computer was used to fit a surface to the laboratory data. The following quadratic equation was applied:

$$Y = B_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_2^2 + B_7X_3^2 + B_8X_4^2 + B_9X_5^2 + B_{10}X_2X_3 + B_{11}X_2X_4 + B_{12}X_2X_5 + B_{13}X_3X_4 + B_{14}X_3X_5 + B_{15}X_4X_5$$

Y = Fabric property (ie, whiteness, fluidity, absorbency)
X_2 = Temperature
X_3 = Time
X_4 = H_2O_2 concentration
X_5 = NaOH concentration
X_n^2 = Second order effect of variable n
X_mX_n = interaction of variables m + n

Using a multiple regression program, the laboratory data were processed through the computer and the values of the coefficient, B_n, in this equation calculated. Sustituting these mathematically determined values for B into this equation along with a selected set of bleaching time, temperature, H_2O_2, and NaOH conditions, the properties of the pressure-bleached cotton can be predicted. Conversely, this equation can be used to determine the sets of operating conditions necessary to obtain desired pressure-bleached fabric properties.

Computer analysis of the pressure-bleaching data also supplied information concerning the relative contribution of each of the variables to each of the fabric properties measured. The statistical measurement used to express this relationship is called the F-ratio. For each of the process variables, as they appear in the prediction equation, an F-ratio was computed relative to each of the fabric properties. Statistical theory shows that where the computed F-ratio is less than 4.3 it is probable that this process variable exerts only a random effect on the bleached fabric property. If the F-ratio is greater than 4.3, this bleaching variable probably contributes to the resulting fabric property.

TABLE II
Relative contributions of pressure-bleaching process variables to fabric whiteness

Variables Having a Major Effect	*F-Ratio*
NaOH concentration	22.0
NaOH concentration, second order effect	17.1
Time	16.8
Time, second order effect	8.5
Interaction of temperature and time	8.1
Interaction of time and NaOH concentration	8.1
H_2O_2 concentration	8.0
Variables Having Little or No Direct Effect	*F-Ratio*
Interaction of time and H_2O_2 concentration	3.2
Temperature, second order effect	2.6
Interaction of temperature and NaOH concentration	1.4
Interaction of temperature and H_2O_2 concentration	0.8
Temperature	0.6
Interaction of H_2O_2 and NaOH concentrations	0.2
H_2O_2 concentrations, second order effect	0.1

TABLE III
Relative contributions of pressure-bleaching process variables to fabric fluidity

Variables Having a Major Effect	*F-Ratio*
NaOH concentration	46.8
Interaction of time and NaOH concentration	15.0
Interaction of temperature and time	12.9
Time	10.3
Time, second order effect	6.2
H_2O_2 concentration	5.6
Variables Having Little or No Direct Effect	*F-Ratio*
Temperature, second order effect	4.3
Temperature	3.5
Interaction of time and H_2O_2 concentration	2.9
Interaction of temperature and NaOH concentration	1.7
H_2O_2 concentration, second order effect	0.5
Interaction of temperature and H_2O_2 concentration	0.2
Interaction of temperature and time	0.1
Interaction of H_2O_2 and NaOH concentrations	0.09

Table II lists the F-ratios for the process variables in the prediction equation corresponding to the whiteness of the bleached fabric. Although the higher temperature of pressure bleaching accelerates the bleaching reaction, these data indicate that ultimate fabric whiteness is independent of operating temperature. Table III contains the F-ratios for the variables relative to the fluidities. These data show that bleaching temperature also has little or no effect on fluidity. Therefore, the increased temperature of pressure bleaching should not have an adverse effect on the whiteness or fluidity of the fabric. However, the F-ratios do show that the whiteness and fluidity of pressure-kier bleached cotton are dependent upon time, H_2O_2 concentration, and NaOH concentration.

With the exception of one sample which was obviously underbleached, all fabrics had good absorbency, the majority in the range of two seconds or less. However, no statistical relationship could be derived for absorbency. This was probably due to the failure of the varying bleaching conditions to produce consistent changes in absorbency.

Three types of graphical representations of these statistical data have been prepared. The first series of graphs was obtained by using the computer to solve the quadratic equation for specified values of the variables with the results being plotted directly by the computer. Five levels were selected for each variable, which resulted in 25 individual graphs each for whiteness and fluidity. Each graph showed the effect of varying NaOH and H_2O_2 concentrations at specific time and temperature levels. Figures 1 and 2 are examples from this series of graphs. The chemical concentrations shown are based on the weight of the fabric (owf).

Data from these graphs were then used to obtain a similar set in which the effect of time and temperature is shown at specified H_2O_2 and NaOH concentrations. Figures 3 and 4 are illustrative of this series.

The data shown in these types of graphs can be

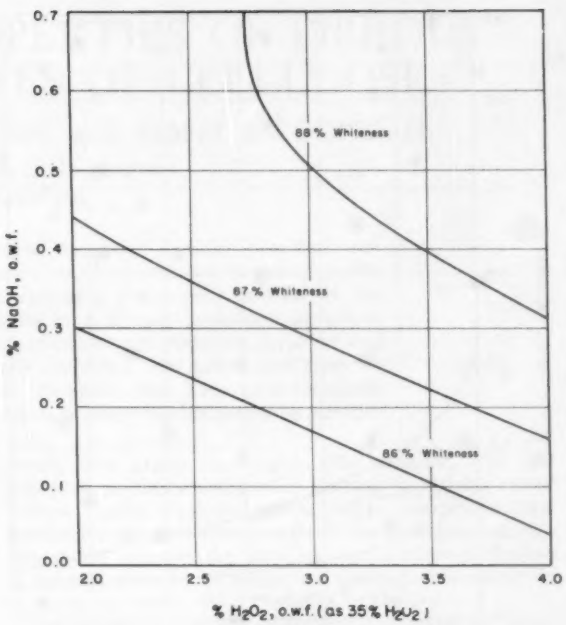

Figure 1
Effect of NaOH and H_2O_2 concentrations on whiteness—25 min, 245°F

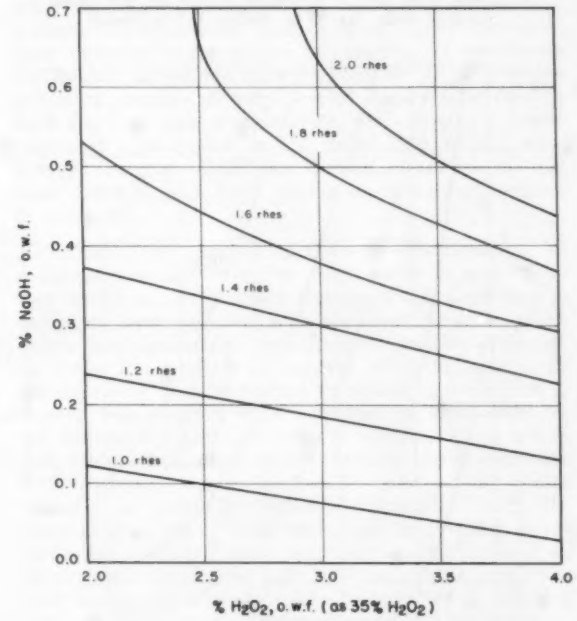

Figure 2
Effect of NaOH and H_2O_2 concentrations on fluidity—25 min, 245°F

combined in three-dimensional graphs which show the effect of three variables simultaneously. Figure 5 shows the surface which represents the conditions of time, temperature, and NaOH concentration necessary to obtain 88% whiteness using 3.0% of 35% H_2O_2.

These graphs can be used advantageously as a basic tool when planning a mill pressure-kier bleaching operation. They illustrate the effect of each of the process variables on the bleaching results, and show the direction of alteration of the variables, relative

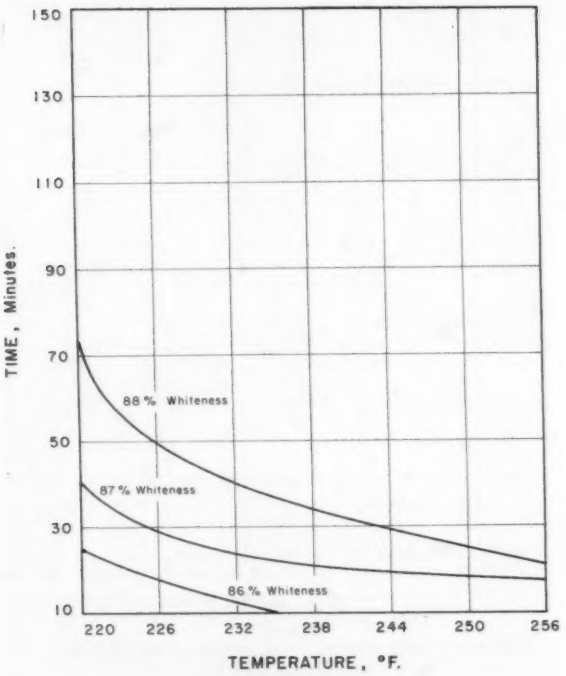

Figure 3
Bleaching time and temperature effect on whiteness—3.0% H_2O_2 (as 35% H_2O_2), 0.5% NaOH

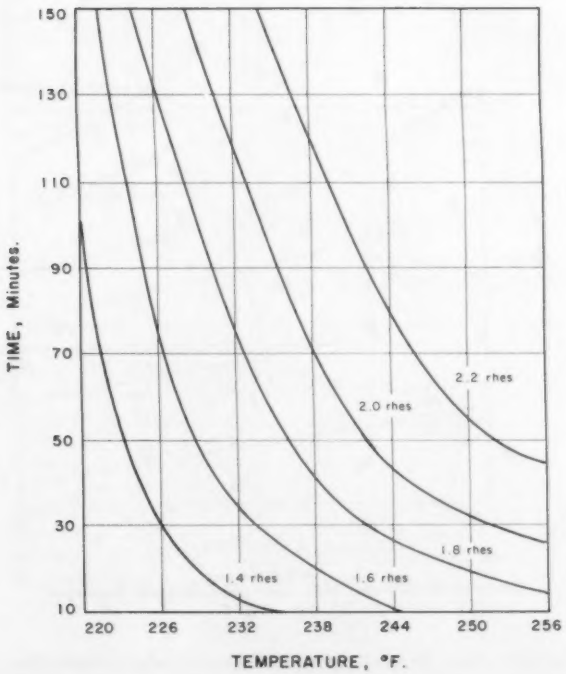

Figure 4
Bleaching time and temperature: effect on fluidity—3.0% H_2O_2 (as 35% H_2O_2), 0.5% NaOH

to each other, to achieve a specific fabric property. This knowledge will then facilitate and provide a basis for estimating the process conditions for optimum results in any specific mill application.

Dyeability tests on the pressure-bleached cotton fabric showed that, in general, high alkalinity in the bleach and high fabric whiteness resulted in deeper color after dyeing. Strength or depth of color is a property chiefly influenced by the quantity of dye picked up by the fabric and by the degree of dye migration. Good absorbency is required to achieve satisfactory dye pick-up. As shown in Table I, all the bleached fabric samples had good absorbency except one underbleached sample. A conclusive evaluation of the effect of this fabric property on dyeability was not achieved by these tests. A representative number of fabric samples dyed in this study were found to have an electrolyte content of 0.03% (as % NaCl). This concentration is lower than that normally encountered in mill bleached fabric. The enzyme extractables and "fats, oils, and waxes" contents of these eight samples were found to be below 0.2% in all cases. Therefore, no definite correlation between these properties and dyeability of the fabric could be derived.

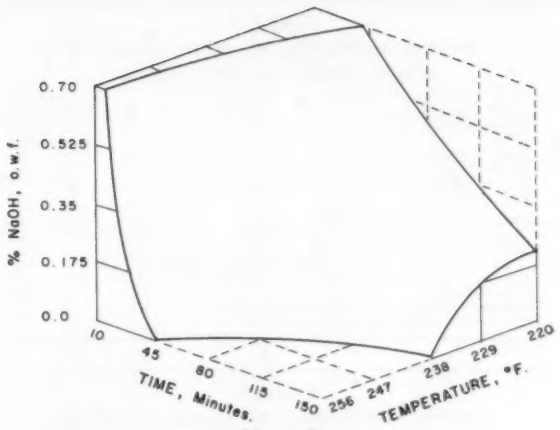

Figure 5
Conditions necessary to obtain 88% whiteness using a 3.0% concentration of 35% H_2O_2

Although comparison of the smoothness of these dyeings was difficult, those with the deeper shade appeared to be generally smoother. A few scouting trials showed that smoothness could be improved where necessary by addition of electrolyte to the dyebath.

CONCLUSIONS

Single-stage pressure-kier bleaching of cotton with hydrogen peroxide is a safe, commercially attractive process capable of producing high-quality bleached cotton fabric in a greatly reduced process time. When fabric to be dyed is bleached by this process, a high alkalinity bleach formula should be used for sufficient time to obtain high whiteness.

SUMMARY

A statistically designed set of experiments has been used to define optimum operating conditions for the single-stage pressure kier bleaching of cotton with hydrogen peroxide. The results of thirty-five laboratory bleaching trials showed that satisfactory bleaching was obtained over a wide range of operating conditions. A digital computer was used to evaluate the laboratory data statistically and to provide practical conclusions as to the relationship between process variables and bleaching results. The higher temperatures (200-250°F) used in this process accelerated bleaching with no adverse effect on fabric whiteness or fluidity. These pro-

(*concluded on page 32*)

PREPARATION AND PROPERTIES OF FIBROUS PARTIAL ISOBUTYRATES OF CELLULOSE

HUBERT H ST MARD, CARL HAMALAINEN, and ALBERT S COOPER JR

Southern Regional Research Laboratory[1]
New Orleans, Louisiana

Cotton cellulose in the form of yarn and fabric has been partially esterified with isobutyric anhydride with retention of the fibrous structure and the excellent textile characteristics of cotton. The process involves activating the cotton, removal of the activating agent, and heating with the anhydride in a diluent containing potassium isobutyrate as the catalyst. The products have excellent strength retention, have rot and heat resistance essentially equal to that of partially acetylated (PA) cotton, and show no appreciable loss in tear and abrasion resistance. However, they have poor resistance to outdoor weathering, which seems to be common to most fibrous esterified cottons.

INTRODUCTION

CONSIDERABLE work has been done at this Laboratory on the esterification of fibrous cotton cellulose with particular emphasis on acetylation. Both partially acetylated (*1, 2*) and fully acetylated (*3*) fibrous celluloses have been prepared and their physical and chemical properties have been extensively evaluated.

The preparation of cellulose isobutyrates has been reported in the literature. However, their preparation involved the use of regenerated cellulose (*4*) and cotton linters or wood pulp (*5, 6*) as the starting materials. In the latter case the products went through a solution stage before being formed. No literature reference was found giving chemical and physical properties of isobutyrylated cotton cellulose in which the fibrous form of the cotton was retained. However, preliminary evaluation, at this Laboratory, of experimental isobutyrylated cotton fabrics prepared by Malm and his coworkers (*8*) indicated that such a product had certain advantages over partially acetylated cotton in some physical properties.

This paper describes the preparation of cotton cellulose isobutyrates with retention of the fibrous structure of the yarns and fabrics, used as the experimental material, and the evaluation of these products as useful textile materials. Comparisons were made with fibrous cotton cellulose acetate, propionate, and mixed acetate-isobutyrate esters similarly prepared.

EXPERIMENTAL

Fibrous acetylation of cotton cellulose is readily accomplished with acetic anhydride using acid catalysts at low reaction temperatures (*1, 2*). Preliminary experiments under similar acid-catalyzed systems with isobutyric anhydride yielded products of low degrees of substitution or highly degraded products of higher degrees of substitution. Attention was thus turned to base-catalyzed systems.

Cellulose in the form of scoured 12/3 cotton yarn was the primary experimental material. A few samples were made from three scoured fabrics—four-ounce lawn, 64 × 60 and 80 × 80 print cloths—under some of the conditions considered optimum for the yarns. A sample of 80 × 80 print cloth was evaluated for some of the fabric properties. A more extensive evaluation was made on 64 × 60 print cloth prepared on large-scale laboratory acetylating equipment.

The yarn was wound into small skeins of approximately five grams in weight. The samples, after the indicated pretreatments, were reacted in 200-ml round bottom flasks equipped with reflux condenser and heated for the various periods of time. Upon completion of the reaction the samples were removed, washed in several changes in methanol, washed thoroughly in running tap water, then hung up to air dry.

The sample size provided sufficient material for yarn-breaking-strength determination, chemical analysis for total acyl content by the Eberstadt method as modified by Genug and Mallatt (*7*), and for a quick dye test using the mixed acetate yellow and direct cotton blue dyebath (*2*) to indicate uniformity of the reaction and some measure of the degree of reaction. It was found that nearly all of the samples dyed a uniform bright yellow or orange. A very few of the samples dyed a dark green or light yellow color, these having a lower degree of substitution in the range of 9 to 14% isobutyryl content. Only one sample reported in this paper dyed a dark blue, having an isobutyryl content of only 5.6%.

EFFECT OF ACTIVATION———Esterification of cellulose with acids higher than acetic is reportedly very sluggish. To increase the reactivity, measures to swell or "activate" the cellulose must first be taken before any appreciable esterification can be expected. In Table I, the effect of various activating agents on the degree of isobutyrylation of skeins of 12/3 yarn is shown. The samples were activated by immersion for the indicated length of time in either boiling water, anhydrous ethylamine, isopropylamine, liquid ammonia, 23% aqueous sodium hydroxide followed by water washing, or pyridine. After the activation step, the samples were given three exchanges in pyridine to remove the activating agent and then reacted slack in an equivolume mixture of isobutyric anhydride and pyridine containing 2% potassium isobutyrate as catalyst, refluxed for two hours, then washed and air dried.

TABLE I
Effect of activation on isobutyrylation of 12/3 cotton yarn

Activating agent (presoak)	*Activation time (min)*	*Isobutyryl content (%)*	*Breaking-strength retention (%)*
Boiling water	30	12.2	104
Anhyd ethylamine	60	44.6	135
Isopropylamine	60	18.3	110
Liquid ammonia	60	50.2	106
23% NaOH (water wash)	15	40.4	116
Pyridine	120	10.9	105

Conditions: After activation, the five-gram yarn samples were given three exchanges in pyridine, reacted two hours under reflux in a solution containing 50 ml of pyridine, 50 ml of isobutyric anhydride, and two grams of potassium isobutyrate, then washed in methanol and then water.

[1] One of the laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, US Department of Agriculture.

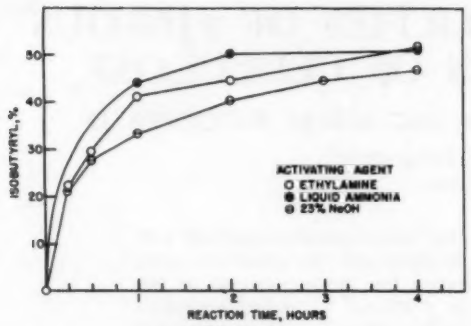

Figure 1
Effect of activation in isobutyrylation of 12/3 cotton yarn

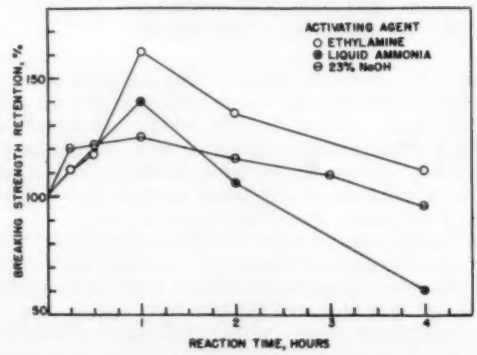

Figure 2
Breaking-strength retention of isobutyrylated 12/3 cotton yarn variously activated

The results shown in Table I indicate that water, isopropylamine, and pyridine are the least effective activating agents. The agents giving the greatest degree of activation are ethylamine, liquid ammonia, and 23% sodium hydroxide.

Figure 1 further illustrates graphically the effect of these latter three agents on the degree of isobutyrylation, which is plotted against the time of reaction. The greatest rise in isobutyryl content occurs during the first hour of reaction. Isobutyryl contents up to 52% were obtained after four hours of reaction. The highest value obtained (not shown) was 54.1% isobutyryl on a sample activated with anhydrous ethylamine and reacted 6.5 hours. This corresponds to a degree of substitution (DS) of 2.65. Theory for DS of 3 is 57.3% isobutyryl.

The combined effect of activation and isobutyrylation on the breaking-strength retentions in these samples is shown in Figure 2. After one hour of reaction, samples activated in ethylamine, liquid ammonia, and 23% NaOH had breaking strength retentions of 161%, 140%, and 125%, respectively. These values are based on the breaking strength of untreated scoured control yarn taken as 100%.

With an increase in the time of reaction beyond one hour, the breaking strengths decreased only slightly when ethylamine or 23% NaOH was used as the activating agent. Under the same conditions the samples activated in liquid ammonia show a somewhat more rapid decrease in breaking strength.

EFFECT OF TIME AND TEMPERATURE——The effect of reacting for various periods of time at different temperatures on the isobutyryl content of 12/3 activated yarns is shown in Figure 3. The refluxing bath temperature was obtained from a thermometer

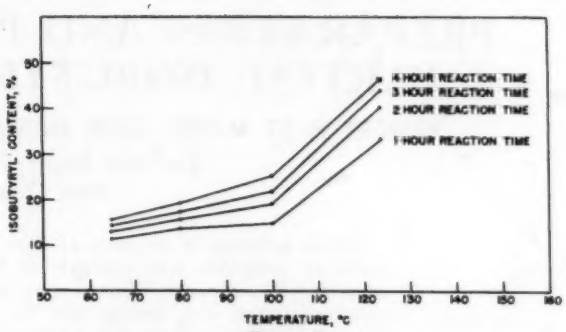

Figure 3
Effect of temperature on isobutyrylation of NaOH-activated 12/3 cotton yarn

TABLE II
Effect of catalyst concentration on isobutyrylation of 12/3 cotton yarn

Catalyst concentration (%)	*Isobutyryl content* (%)	*Breaking-strength retention* (%)
0	16.0	114
0.25	20.9	120
0.50	26.0	117
1.0	25.9	116
2.0	30.5	116
3.0	31.7	110
4.0	33.7	113

Conditions: Samples consisted of five-gram skeins of 12/3 cotton yarn activated in 23% NaOH, water washed, solvent exchanged with pyridine, reacted in solution containing 50 ml of pyridine, 50 ml of isobutyric anhydride, and the indicated amount of potassium isobutyrate, refluxed for one hour, washed in methanol and then water.

lowered into the boiling liquid in which the yarn sample was reacting. The reported temperatures of 65, 80, and 100°C were obtained from the temperatures of water baths into which the reaction flasks were immersed.

Temperatures under that of reflux (127°C) are ineffective for a high degree of substitution. A four-hour reaction at 100°C resulted in a product with only 25.2% isobutyryl content compared with 33.3% isobutyryl after one hour reaction under refluxing conditions. The breaking-strength retentions of all the samples reacted at temperatures lower than that of reflux were excellent, being in the range of 117 to 130% of that of the untreated control yarn, indicating no appreciable degradative effects due to the reaction. If isobutyryl content up to 25% is all that is required for a practical application, then reacting at 100°C is adequate. For higher isobutyryl substitutions, refluxing conditions are indicated.

EFFECT OF CATALYST——The effect of varying the amount of potassium isobutyrate catalyst on the degree of reaction is shown in Table II. An appreciable degree of isobutyrylation is obtained with no potassium salt present, indicating the catalytic effect of pyridine alone. Increasing the salt content up to 4% more than doubled the amount of substitution. The potassium isobutyrate concentration had no appreciable effect on the breaking-strength retention of the yarn samples.

EFFECT OF SOLVENT EXCHANGE AND DILUENTS——After pretreatment with 23% NaOH it is necessary to wash out the caustic and then to remove the water by solvent interchange in order to leave the cotton cellulose in a highly swollen condition, rendering it accessible to reaction with isobutyric anhydride. Several solvents were tried in the exchanging of the water from the activated yarns with the results shown

TABLE III

Effect of solvent exchange on isobutyrylation of 12/3 cotton yarn

Solvent and no. of exchanges	*Temperature of reaction* (°C)	*Isobutyryl content* (%)	*Breaking-strength retention* (%)
Pyridine, 3X	127	33.3	125
Methanol, 2X; Pyridine 3X	123	33.0	126
Acetone, 3X; Pyridine 1X	123	29.4	121
Acetone, 3X	104	14.9	120
P-Dioxane, 3X	122	23.3	119
Dimethylformamide, 3X (DMF)	130	30.9	119

Conditions: Samples consisted of five-gram skeins of 12/3 cotton yarn activated in 23% NaOH, water washed, solvent exchanged as indicated above, reacted in solution containing 50 ml of pyridine, 50 ml of isobutyric anhydride, and two grams of potassium isobutyrate, refluxed one hour, washed in methanol and then water.

TABLE IV

Effect of solvent exchange and diluent on isobutyrylation of 12/3 cotton yarn

Solvent and no. of exchanges	*Diluents*	*Temp of reaction* (°C)	*Isobutyryl content* (%)	*Breaking-strength retention* (%)
Pyridine, 3X	Pyridine	127	33.3	125
Pyridine, 3X	Isobutyric acid	*	14.4	115
Pyridine, 3X	60% Pyridine, 40% isobutyric acid	139	17.8	110
Pyridine, 3X	80% Pyridine, 20% isobutyric acid	132	22.1	108
Acetone, 3X Isobutyric acid 1X	Isobutyric acid	*	9.1	113
Acetone, 3X Isobutyric acid 1X	20% Pyridine, 80% isobutyric acid	*	11.9	113
Dimethyl-formamide, 3X	DMF	158	28.4	118
Acetone, 3X,DMF 1X	DMF	155	27.2	116
Acetone, 3X,DMF 1X	20% Pyridine, 80% DMF	145	27.5	118
Acetone, 3X,DMF 1X	40% Pyridine, 60% DMF	140	28.7	113

*No record of temperature

Conditions: Samples consisted of five-gram skeins of 12/3 cotton yarn activated in 23% NaOH, water washed, solvent exchanged as indicated above, reacted in solution containing 50 ml of isobutyric anhydride, 50 ml of diluent as indicated, and two grams of potassium isobutyrate, refluxed one hour, washed in methanol, then water.

in Table III. All of the solvents appeared to be effective in removing the water and leaving the yarn in a highly reactive state.

The low value for the sample receiving three exchanges in acetone is explained by the fact that an appreciable residue of solvent is carried over into the reaction flask, thereby reducing the refluxing temperature normal to the 50:50 mixture of pyridine and isobutyric anhydride. The previous sample receiving three acetone exchanges followed by one pyridine exchange showed a much higher value.

In Table IV is shown the combined effect of the solvent exchange and the diluent for the isobutyric anhydride on the degree of isobutyrylation of the NaOH-activated yarn. The results indicate that pyridine is the best both for the solvent exchange and as the diluent for the reaction. Dimethylformamide is next best, although the actual reaction temperatures with its use are much higher and therefore higher acyl values should have been expected. The presence of isobutyric acid actually seems to inhibit the amount of reaction with the cotton.

EFFECT OF ISOBUTYRIC ANHYDRIDE CONCENTRATION———In Table V is shown the effect of the isobutyric anhydride concentration on the degree of isobutyrylation of 12/3 cotton yarn. There is an appreciable increase in the amount of reaction from 10 to 20% anhydride content beyond which the rate of increase is greatly diminished. The maximum substitution occurs in the 50:50 volume ratio of solution. Use of solutions with higher ratios of anhydride resulted

TABLE V

Effect of anhydride concentration on isobutyrylation of 12/3 cotton yarn

Isobutyric anhydride (ml)	*Pyridine diluent* (ml)	*Reaction temperature* (°C)	*Isobutyryl content* (%)	*Breaking-strength retention* (%)
0	100	112	0.0	131
10	90	117	13.2	120
20	80	120	24.3	119
30	70	122	25.9	118
40	60	125	27.8	116
50	50	127	33.3	125
70	30	137	24.9	115
90	10	148	22.1	123
100	0	157	20.1	115

Conditions: Samples consisted of five-gram skeins of 12/3 cotton yarn activated by 23% NaOH, water washed, solvent exchanged with pyridine, reacted in 100 ml of total solution of indicated composition containing two grams of potassium isobutyrate, refluxed one hour, washed in methanol and then water.

TABLE VI

Effect of isobutyric acid on the isobutyrylation of 12/3 cotton yarn

Isobutyric anhydride (ml)	*Isobutyric acid* (ml)	*Pyridine diluent* (ml)	*Reaction temperature* (°C)	*Isobutyryl content* (%)	*Breaking-strength retention* (%)
10	0	90	117	13.2	120
10	40	50	135	5.6	124
20	0	80	120	24.3	119
20	30	50	136	14.4	119
50	0	50	127	33.3	125
50	10	40	132	22.1	108
50	20	30	139	17.8	110
50	50	0	—	14.4	115

Conditions: Samples consisted of five-gram skeins of 12/3 cotton yarn activated by 23% NaOH, water washed, solvent exchanged with pyridine, reacted in 100 ml of total solution of indicated composition containing two grams of potassium isobutyrate, refluxed one hour, washed in methanol and then water.

TABLE VII

Effect of re-use of reaction solutions on isobutyrylation of 12/3 cotton yarn

Use number	*Temperature of reaction* (°C)	*Isobutyryl content* (%)	*Breaking-strength retention* (%)
First	126	30.0	123
Second	125	22.1	123
Third	123	16.7	121
Fourth	122	13.7	127

Conditions: Samples consisted of five-gram skeins of 12/3 cotton yarn activated by 23% NaOH, water washed, solvent exchanged with pyridine, reacted in solution initially containing 50 ml of pyridine, 50 ml of anhydride, and two grams of potassium isobutyrate, refluxed one hour each in the solution or spent solutions respectively, washed in methanol and then water.

in products showing significant reductions in isobutyryl substitution. This is contrary to the experience with acetic anhydride in which an increase in acetyl substitution is shown even to the use of 100% anhydride.

EFFECT OF ISOBUTYRIC ACID CONCENTRATION———In Table VI is shown additional evidence indicating the depressing effect of isobutyric acid on the esterification reaction. Some of the values are duplicated from Table IV to emphasize the effect of the isobutyric acid on the acylation reaction. There is a considerable reduction in isobutyryl substitution with increasing concentrations of the acid at the constant anhydride levels indicated.

This effect is further indicated by the results of an experiment shown in Table VII in which the same reaction solution is used for four successive isobutyrylations of four different skeins of yarn of same size resulting in decreasing isobutyryl content; although by calculation there still should have been sufficient anhydride in the fourth use of the solution to fully substitute the cotton cellulose sample. In the acylation reaction there is an increase in the isobutyric acid content with corresponding decrease in the anhydride content.

TABLE VIII
Isobutyrylation of fabric

Fabric, size & weight	*Solvent and no. of exchanges*	*Diluent*	*Reaction temp (°C)*	*Reaction time (hrs)*	*Isobuty content (%)*
Four-ounce lawn					
(61″ x 5½″) 22g	Acetone 3X, DMF 1X	Pyridine	100	3	10.9
(61″ x 5″) 18g	Acetone 3X, pyridine 1X	Pyridine	100	3	11.4
(58″ x 5″) 16½g	Acetone 3X, DMF 1X	DMF	100	3	5.6
64 x 60 Print cloth					
(48″ x 5″) 13½g	Acetone 3X, DMF 1X	Pyridine	100	3	14.3
(47″ x 4″) 11½g	Acetone 3X, pyridine 1X	Pyridine	100	3	17.3
(48″ x 4″) 11g	Acetone 3X, DMF 1X	DMF	100	3	7.9
(48″ x 8½″) 21g	Pyridine 3X	Pyridine	100	3	11.9
(48″ x 8½″) 22g	Pyridine 3X	Pyridine	100	4	16.7
80 x 80 Print cloth					
(36″ x 7½″) 20g	Pyridine 3X	Pyridine	127	2¼	21
(36″ x 8″) 19½g	Pyridine 1X	Pyridine	128	2	15
(75″ x 13″) 67g	Pyridine 3X	Pyridine	126	2	21.8

Conditions: The fabric samples of the indicated size and weight were activated in 23% NaOH, water washed, solvent exchanged as indicated, reacted in equivolume solution of isobutyric anhydride and diluent containing 2% potassium isobutyrate, heated at temperature and for time indicated, washed in methanol and then water.

TABLE IX
Physical properties of isobutyrylated 80 x 80 print cloth

Sample	*Breaking-strength (lbs)*	*Elmendorf tear (gms)*	*Stoll flex abrasion (cycles)*
Orig untreated control	41.26	764	283
Mercerized control	51.02		
Isobutyrylated (21.8%)	54.14	728	216
After seven-day heat test 160°C	37.90		

For any esterification procedure to become practical, it must lend itself to ease of regeneration of spent reaction solutions or to economical recovery of chemicals. Although the reaction mixture may be fortified by addition of isobutyric anhydride, some method must be found to effectively reduce or inhibit the effect of the isobutyric acid which is formed. Hence, in its present status, this must be considered a batch-type process which may or may not be economically practical, requiring additional experimentation to convert it into an economically feasible continuous process.

ISOBUTYRYLATION OF FABRIC——Samples of fabric of various construction, weight, and size were isobutyrylated as listed in Table VIII. The fabric samples were activated slack in 23% NaOH, washed free of alkali in tap water, given a mild acid sour, and washed again. After the water was exchanged with solvent, the fabric was rolled up in a layer of glass cloth and reacted in a glass cylinder containing a solution having equal volumes of isobutyric anhydride and the diluent with 2% potassium isobutyrate as catalyst. The cylinder, equipped with a reflux condenser, was immersed in boiling water to achieve the desired reaction temperature of 100°C for eight of the samples. The samples which were reacted at the higher temperatures were heated by means of heating tapes wound around the glass cylinder to maintain refluxing conditions. After the reaction, the samples were washed in methanol and then water.

As was the case with 12/3 yarn, the fabric samples which were reacted in pyridine as the diluent for the isobutyric anhydride and also as the water exchange solvent showed the highest amount of substitution. Exchanges in acetone followed by one exchange in pyridine were as effective as three pyridine exchanges. Refluxing conditions, as would be expected, gave higher substitution with lesser time of reaction than reacting at 100°C.

A preliminary evaluation of the isobutyrylated 80 × 80 print cloth sample containing 21.8% isobutyryl content was made. As seen in Table IX, the breaking strength was greater than that of the untreated control and even greater than the mercerized control, indicating no appreciable degradation of the cotton. There was no significant loss in Elmendorf tear strength and only a slight decrease in Stoll flex abrasion, indicating the retention of the excellent textile characteristics of cotton. The heat resistance is essentially equivalent to that of PA cotton, ie, approximately 70% breaking strength retention after heating seven days at 160°C. Although the weather resistance was poor, showing no measurable strength after five and one-half months outdoor weather exposure compared with untreated control fabric which retained 66% of its strength after six months, the rot resistance was excellent, showing no loss in strength after 48 weeks in the soil-burial beds.

To facilitate a more complete fabric evaluation, several larger samples of scoured and bleached 64 × 60 construction print cloth were esterified. These fabrics (16 inches × six yards) were activated in 23% NaOH on a small jig with continuous rolling. They were water washed and excess water was squeezed out on the padder rolls. They were rolled wet in a single layer of glass fabric and were given three acetone and two pyridine exchanges. The samples were reacted in the laboratory acetylating equipment as described by Buras et al (3).

A sample of each of the following fabric esters was prepared: isobutyrate, mixed acetate-isobutyrate, acetate, and propionate. They were reacted in equivolume quantities of the respective anhydride and pyridine. The corresponding potassium salt was used as the catalyst. In the preparation of the mixed ester, an anhydride ratio of one part acetic to six parts isobutyric was used to favor the formation of the higher ester because of the greater reactivity of the acetic. Potassium isobutyrate was used as the catalyst for the same reason.

The physical properties of these fabrics were determined and compared with each other and also with a scoured control, NaOH-treated control and an acetate prepared by the perchloric acid-catalyzed method. The results of these physical tests are shown in Table X.

The breaking-strength values indicate that none of the esters lost strength due to the treatment. The strengths of the alkaline salt-catalyzed esters were in the range of that of the mercerized control, and the acid-catalyzed acetate (PA) was similar to that of the scoured control. The mercerized samples were the stronger, as would be expected. The differences in the thread count may be due to different tensions in pulling out of the fabric during drying on the tenter frame, especially noted in the mercerized control. The thread-breaking-strength values are calculated values and probably indicate more accurately the relative strengths of the samples.

The isobutyrate ester showed the highest percent elongation at break, being nearly double that of any

TABLE X

Physical properties of esterified 64 x 60 print cloth

Fabric	Breaking-strength, one-inch strip (lbs)	Thread count per inch	Breaking strength (lbs/thread)	Elongation at break (%)	Energy to rupture inch (lbs)	Elmendorf tear strength-warp (gms)	Flex abrasion (cycles)	Weight (oz / yd²)	Stiffness bending moment x10⁻⁴ in lbs	Spray test rating	Water retention (%)
Isobutyrate 36.7%	48.8	81	.603	28.0	20.5	648	145	5.3	9.1	50	10.3
Acetate isobutyrate[1]	59.2	79	.749	13.3	14.6	904	86	4.2	17.1	0	11.8
Acetate 28.9%	64.3	80	.809	15.4	17.2	996	91	4.4	16.5	0	10.9
Propionate 27.2%	55.3	78	.709	13.6	13.3	872	90	4.0	4.2	0	13.7
PA control 26.0%	41.9	72	.583	14.6	5.4	624	72	3.6	39.6	0	12.2
Mercerized control	47.2	85	.556	5.9	7.7	944	259	3.1	19.8	0	35.7
Scoured control	41.5	71	.584	6.5	7.4	836	86	2.5	2.9	0	28.5

[1] Acetyl 19.3%
Isobutyryl 8.1%

TABLE XI

Wrinkle recovery of esterified cotton 64 x 60 fabric

	Unautoclaved		Autoclaved	
	Dry W and F[1]	Wet W and F[1]	Dry W and F[1]	Wet W and F[1]
Isobutyrate	202	134	198	179
Acetate-isobutyrate	192	82	191	183
Acetate	191	[2]	196	165
Propionate	206	117	204	185
PA control	137	[2]	162	146
Mercerized control	147	168	172	163
Scoured control	210	163	198	157

[1] Crease recovery angle, warp and fill, in degrees.
[2] Too low for reading.

other ester. This is also reflected in the value for the energy to rupture, which is a function of the shape of the stress-strain curve. The Elmendorf tear resistance of the isobutyrate ester was considerably lower than that of the mercerized and scoured controls but higher than that for the acid-catalyzed acetate. The basic salt-catalyzed acetate had the highest tearing strength value, being even higher than that for the mercerized control. The isobutyrate ester had the greatest flex abrasion resistance of all the esters but not as good as the mercerized control. The weight analysis reflects the high weight add-on of the isobutyrate group. The isobutyrate and propionate esters were slightly stiffer than the scoured control but appreciably less stiff than the mercerized control. The stiffest fabric was the acid-catalyzed PA. The isobutyrate fabric was somewhat hydrophobic, as shown by the results of the spray test. Its water retention was the lowest of all of the esters and approximately one third that of the controls.

Portions of each ester sample were autoclaved for 20 minutes at 20 pounds steam pressure. Both dry and wet crease-recovery angles were determined on these as well as on samples which were not autoclaved. The results found in Table XI show that the autoclaving had no effect on the dry but showed an appreciable improvement in the wet wrinkle recovery.

The fabrics were evaluated for immediate elastic recovery, delayed recovery and permanent set, employing the calculated values at 25%, 50%, and 75% of the ultimate elongation. The results showed that the esters exhibited slightly higher permanent set and slightly lower immediate elastic recovery at the higher levels of elongation when compared with the control fabrics.

Since highly substituted chemically modified celluloses are said to be thermoplastic, it was of interest to determine whether these esters would show a second-order transition or a softening temperature. Samples were heated under constant load and were found to elongate at a steady rate with increasing temperature up to 200°C. There was no evidence of a break in the elongation curve, which would indicate a definite transition or softening temperature.

SUMMARY

The partial isobutyrylation of scoured cotton yarn and fabric has been accomplished through a base-catalyzed esterification procedure. The products retain the fibrous structure of the textile materials. The cotton must initially be activated in order for the esterification to proceed to any appreciable degree of substitution. Best activation was achieved by swelling the cotton in anhydrous ethylamine. A more practical yet also highly effective method of activation is mercerizing in 23% NaOH solution followed by water washing and then removal of the water by solvent interchange. Pyridine was most effective as the solvent for the water exchange and also as the diluent for the anhydride. Use of acetone to exchange the water followed by one pyridine exchange was also effective. The reagent mixture most effective for the highest substitution was equal volumes of the anhydride and pyridine containing 2% potassium isobutyrate as catalyst. The highest substitution was in a yarn sample activated with ethylamine and reacted six and one-half hours in refluxing anhydride-pyridine mixture. It had 54.1% isobutyryl content, corresponding to a degree of substitution of 2.65. The presence of isobutyric acid seemed to inhibit the esterification reaction and for the procedure to assume practicability some method must be found to effectively reduce or remove the isobutyric acid formed.

A rather extensive evaluation of the physical properties of partially isobutyrylated cotton fabric shows that this ester retains most of the excellent textile properties of cotton and has physical properties approximately equal and in some cases superior to the other cellulose esters used for this comparison.

ACKNOWLEDGMENTS

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Evaluation of Variables in the Pressure-Kier Bleaching of Cotton ———

(*concluded from page 26*)

perties were dependent on time, alkalinity, and peroxide concentration. Absorbency was good in all samples bleached to acceptable whiteness, but no statistical relationship was found between this property and process variables.

The computer also provided graphs which illustrate the relationship between operating variables and bleaching results. These graphs can be used to establish optimum pressure-kier bleaching conditions with a minimum of mill trials.

Dyeability tests showed that fabric bleached by this process to a high whiteness with good absorbency could be dyed. Correlation of dyeing results with bleaching conditions indicated that increasing the alkalinity of the bleach would increase the depth of color obtained. No relationship was shown between dyeability and other bleaching variables or analytical data on the fabric.

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TRADEMARKS

Albone is Du Pont's trademark for its hydrogen peroxide. Versenex is Dow Chemical Co's trademark for its sodium diethylenetriaminepentaacetate.

ADR ABSTRACTS

The Effect of Temperature and pH on the Adsorption of Basic Dyes by Wool

Bird, C L and Stancev, G P, *J Soc Dyers & Col 77*, 244-6, June 1961

In the early days of the synthetic dyestuffs industry, basic dyes were of some importance on wool, as they enabled the dyer to produce brilliant shades which had hitherto been unobtainable. When acid dyes of similar hue became available, most basic dyes were discarded owing to their inferior fastness properties. At present, however, the behavior of basic dyes towards wool is of some interest in connection with their use for dyeing unions of wool and certain acrylic fibers, eg, Orlon and Courtelle.

The authors have studied the effect of temperature and acidity on the adsorption of basic dyes by wool, using seven dyes of different chemical constitutions.

Dyeings were made on wool skeins in a "Dyeometer" (Ganz & Co), which permits the exhaustion of the dyebath to be measured at any time without disturbing the dyeing. The results obtained at 40°, 60°, and 80°C are tabulated, and the equilibrium exhaustion at various pH values is illustrated by curves.

The tests indicate that, in relation to wool, basic dyes are rapid-dyeing dyes of rather low affinity, suitable for application at relatively low temperatures. Their exhaustion is very sensitive to changes of pH in the region pH 4-6.

The authors explain that the primary source of attraction in the wool is provided by the carboxyl groups. With fall in pH the wool acquires an increasing positive charge, which repels the positively charged dye ions.

Compared with wool, acrylic fibers containing acid groups, eg, Orlon and Courtelle, have much higher affinity for basic dyes, and exhaustion of the dyebath appears to be less sensitive to pH; this is certainly the case with the related fiber Acrilan 16. Consequently, unions of this type of acrylic fiber and wool can be dyed with selected basic dyes at the boil at pH 3-5 without heavy staining of the wool taking place, although the newer cationic dyes developed especially for acrylic fibers are in general better in this respect than the classical basic dyes.

Ten references to the literature are cited.

•

Systems for Bonding Polyurethane Foam to Textiles

Woo'ford, D M and Ma'k'n, B N, *Man-made Textiles 38*, 61-2, June 1961

There is a rapidly increasing interest throughout the textile industry in the use of textile fabrics combined with polyurethane foam. It appears that this type of material will eventually have a wide field of application in the garment industry, as tailoring qualities can be imparted to fabrics which do not otherwise possess them, while clothing suitable for winter wear can be produced from summer-weight fabrics. Foam-backed textiles suitable for overcoats and jackets for men, raincoats and suits for women, and a variety of children's wear can be produced.

Besides providing warmth without weight, a polyurethane foam backing will improve both the crease-resisting qualities and the recovery properties. Knitted fabrics, which are particularly liable to distortion in wear, are rendered dimensionally stable, giving the tailoring qualities already mentioned.

The foam backing will not, however, render shrinkproof a fabric which normally shrinks on washing. Synthetic fiber fabrics should first be heat-set, and cellulosic fabrics stabilized by resin treatment.

Two distinct types of foam are at present available: polyether foams, which are more resilient but tend to swell in solvents used in drycleaning, and polyester foams, which are less resilient but are resistant to all drycleaning solvents.

Three systems are in use for combining foams to fabrics. They can be generally described as flame-bonding, adhesive bonding using a solvent base, and adhesive bonding with an aqueous base; each having its own peculiarities.

The flame-bonding technique consists of rendering the foam surface tacky by passing through a flame and pressing to the fabric so that combining takes place before the foam has cooled. This process naturally requires specialized equipment.

The solvent-based adhesive system employs solutions of either natural rubber or synthetic materials, which may be applied by conventional techniques. Inflammable or toxic solvents must be used, and a suitable solvent extraction plant is necessary.

The system using adhesives based on an aqueous emulsion gives results comparable in every way, the authors say, with the best obtainable by flame bonding or solvent-based adhesive techniques, while no fire hazard is incurred and conventional equipment can be used successfully.

In general, the aqueous-based adhesives currently available for this purpose consist of reactive copolymer

dispersions of acrylic esters, which are either self-crosslinking or are used in conjunction with thermosetting resins. The adhesive can be applied by either doctor knife, roller, or spray. Full details of the process are provided.

•

Observations on the Identification of Acrilan, Acrilan 16, and Courtelle

Ball, J T, *J Soc Dyers & Col 77*, 251-2, June 1961

The acid dye Orange II may be used to distinguish between Acrilan and Courtelle because of the greater affinity of Acrilan for acid dyes. However, there is still some difficulty in identifying these two fibers, and now, with the introduction of Acrilan 16, it is necessary to differentiate between three similar materials.

Microscopical tests. Acrilan 16 may be distinguished from the other types by its definite bean-shaped cross-section. There is, however, a difference between normal Acrilan and Courtelle which appears to be the basis of the method used by several laboratories to distinguish between them. This difference is in the number and size of delustrant particles within the fibers, those in Courtelle being more numerous and more finely dispersed than those in Acrilan.

Staining tests. These are convenient because they avoid the necessity for using a microscope. Suitable stains are Shirlastains A and B (ICI). These are applied to the fiber, both cold and at the boil. The stains obtained on the three fibers in the four tests are recorded in tabular form; eg, Shirlastain A, applied at the boil, gives a brown-olive on normal Acrilan, a light yellow-brown on Acrilan 16, and practically no stain on Courtelle.

Solvent tests (recommended by The Textile Institute). The fibers are treated with dimethyl formamide. At 20°C Courtelle dissolves in 15 min; Acrilan 16 is not completely dissolved after 35 min. At 55°C Acrilan dissolves in eight min; Acrilan 10 dissolves in less than 30 sec.

The author cautions that these tests apply to undyed fibers, and it is possible that some dyes might affect the solubility of dyed fibers.

Three references to the literature are cited.

•

The Mechanism of Adsorption of Disperse Dyes by Cellulose Acetates and Other Hydrophobic Fibers

Giles, C H, *Textile Research J 31*, 141-51, Feb, 1961

The chemistry of dyeing of the hydrophobic fibers with nonionic dyes has long been a subject of investigation, and many detailed quantitative data of adsorption by cellulose acetates and polyester fibers have been published in the last few years. Recent quantitative data for adsorption of disperse dyes on the acetates, and the relations between adsorption and dye structure, are discussed by the author.

The dye probably enters the fiber partly in monodisperse and partly in associated form, he says, and penetrates between the fiber chains in regions inaccessible to water. This type of adsorption produces the characteristic linear adsorption isotherms.

Several properties of the dye molecule determine the maximum adsorption of dye:

Size. The smaller the molecule the easier it can penetrate into the fiber structure, hence the higher the maximum adsorption.

Number of hydrogen donor atoms. The more donor atoms there are, the higher is the adsorption, in certain cases; the dye forms ——OH. . . and ——NH . . . bonds with the fiber.

Number of hydrogen acceptor atoms. The dye forms ——CH . . . O, ——CH . . .N, and ——CH . . .Cl bonds with the CH_3 groups of the acetyl residues in the fiber.

In some cases adsorption rises with the number of acceptor atoms; in some cases it *falls* because of opposing electronic effects of other substituent groups.

Steric effects. There is a tendency for wide spacing (eg, 1:4 disubstitution) of bonding atoms to reduce adsorption, probably by promoting dye-dye association rather than dye-substrate association.

Nylon and polyester fibers appear to adsorb dyes by similar mechanisms, the polyesters showing additional (aromatic nucleus) dye-fiber association.

Dye "carriers" appear to be adsorbed by two mechanisms: penetration into parts of the substrate inaccessible to water (probably the crystalline regions, since the amounts are greatly in excess of the normal moisture regain), which gives linear isotherms; and condensation in internal pores thus opened up (or on the outer surface).

Many basic dyes are hydrolyzed in water and may be adsorbed by cellulose acetate as the free bases (eg, Chrysoidine, CI 11270), which would penetrate regions inaccessible to water. This would account for the superior lightfastness of several basic dyes on this substrate and other hydrophobic fibers, compared with hydrophilic fibers (eg, cotton, wool, silk) as observed by Schwen and Schmidt.

Thirty-one references to the literature are cited.

•

Developments in Dyes and Dyeing

Henley, R W, *Dyer 125*, 349-53, Mar 10, 1961

Although no entirely new dyeing methods have been discovered during the past 12 months, there have been some extremely interesting developments of methods already established, the author states.

Wool. The Peters-Stevens method of dyeing wool from solutions of dyestuffs containing quantities of organic solvents has received considerable attention during the past year. It has been shown that the first practical extension of this process, viz, that of dyeing with acid dyes for times of 1-2 minutes at room temperature in a liquor of 85-100% formic acid, has been used with equal success in screen printing.

Also, bulk dyeings have been carried out on loose wool and slubbing, using benzyl alcohol as the solvent.

It has been shown that dyeing wool at the boil (by the normal method) with formic acid causes less loss in strength than dyeing with either sulfuric or acetic acid.

Cellulosics. High-temperature dyeing techniques, originally designed for synthetic fibers, have been successfully adapted for the processing of cotton sliver containing appreciable amounts of dead fibers.

Investigations into the vat dyeing of cotton, particularly by the vat pigment process, have shown that the particle size has a considerable effect on various properties, eg, rate of reduction, color yield, and stability of the dispersion. The smaller the particle size, the higher is the rate of reduction, which in turn leads to a higher color yield.

Nylon. A continuous high-temperature process for dyeing Kapron (polyamide fiber) fabrics has been reported. The fabrics were padded with acid, disperse or direct dyes, dried, and then heat-set at 195-200°C by infrared radiation.

Polyesters. Probably the most important development has been the introduction of the new range of Esterophile dyes. These specially developed dyes are dispersed pigments, which are soluble in polyesters and are applied at 110-130°C, or with carriers at the boil. They

exhibit outstanding brightness and fastness to light and sublimation.

The solvent dyeing of polyester fibers with disperse dyes has been investigated, using an aqueous emulsion of a solvent solution of dye. Such dyeings, made at the boil, are said to be much deeper than dyeings made with aqueous dispersions at 250°F.

Acrylics. Cationic dyes are now available which enable Orlon to be dyed to withstand 500 hours in the Weather-Ometer. Light to heavy shades have been obtained on blends of Zefran acrylic fiber with cotton, using vat dyes at 120-180°F.

The dyeing properties of Acrilan and Acrilan 16 have been studied. Basic dyes dye Acrilan 16 quicker than Acrilan, whereas acid dyes have no affinity for Acrilan 16 but dye Acrilan readily.

Two new methods of dyeing glass fibers are also described.

Forty references to the literature are cited.

•

The Acid Shock Process

Fletcher, R E, *Dyer 125*, 582-3, April 21, 1961

"There is a trend now," the author says, "for the consumer to demand extra fastness from textiles, and wetfastness of disperse-dyed nylon materials has been suspect on more than one occasion. The dyer has, therefore, been forced to look to the acid wool and metal-complex dyestuffs for the higher fastness he requires, only to find that they emphasize differences in the chemical and physical properties within the nylon piece (barriness) which the disperse dyes so conveniently covered."

Dyers are looking for a continuous process for dyeing nylon which is capable of producing nonbarry shades with first-class fastness properties.

After referring to alternative processes available for the level dyeing of nylon, the author describes the "acid-shock" process. The principle of this process depends on an initial application of the dye to the fiber in a perfectly level manner, followed by rapid fixation of the dye in a later stage.

The nylon fabric must be thoroughly scoured and uniformly dried. A bleaching treatment also helps by giving a cleaner and whiter ground.

The cloth is padded with a thickened dye solution (acid or metal-complex dyes) in a two-bowl padder. The material should leave the nip directly and should not be allowed to lap on either roller on its way out. It is then dried.

Fixation of the dye follows, in a boiling acid bath. A jig may be used for this purpose, or an open-width washing range. In a jig, the cloth is given three ends, or about 10 seconds.

After the acid fixation treatment the fabric is washed to remove the thickener.

The author also discusses the so-called "Cibaphasol" dyeing process.. (Full details of this process will be found in the December 12, 1960 issue of *American Dyestuff Reporter*).

•

Electrostatic Flocking

Anon, *Man-made Textiles 38*, 49, 51, April 1961

Electrostatic flocking is not new, but for a long time it was only possible to project comparatively short flocks (0.3-1.0 mm staple length) by means of an electrostatic field onto a base fabric covered with adhesive. Viscose fibers were used at first, but in recent years nylon and Perlon have also been used.

After years of development work it has now become possible to project longer fibers, and now the manufacture of flock carpets has begun, using fibers up to 7 mm staple length, or even longer.

This new technique opens up wide perspectives promising, ultimately, a complete revolution in manufacturing processes in large sections of the textile industry, the author says. A cheaper method of manufacture has come into being which applies not only to carpets but also to curtains, furnishings, wall coverings, slipper materials, imitation furs, overcoats, and probably many other end-uses.

Two German firms have played a prominent part in this achievement, one producing the flocking machinery while the other produces the flock.

A continuous flock-printing plant located in Cologne-Braunsfeld is described. This plant projects Perlon flock onto a base of jute or other fabric up to a width of 200 cm. The fabric after receiving the flock is dried by infrared heat.

The problem in flock-printing consists in maintaining the fibers in a vertical position during their flight from the positive to the negative pole, and in maintaining a uniform distance between the fibers. The density of the pile is determined by the fabric speed as it passes through the flocking machine, and by the intensity of the electrostatic field, the voltage of which may be 80,000 or more.

With the above equipment a great variety of articles can be produced in addition to carpets, the author says. Good effects can be obtained by mixing fibers of different colors.

FUTURE PAPERS

Following is a list of specially contributed papers which will appear in future issues of *American Dyestuff Reporter:*

"Use of Modern Home Laundry Equipment. II. Cleaning and Wrinkling Effects of Low-temperature Wash Solutions on Naturally Soiled Blouses"———Nada D Poole, Enid S Ross, and R Katherine Taube, Clothing and Housing Research Div, ARS, USDA

"Change in Cloth during Washing with Water and Anionic Detergent"———Virginia C Ester, Norma Hollen, and Rachel Edgar, Iowa State Univ

"The Effect of the Unsaturated Group on the Weathering of Chemically Modified Cottons"———Ricardo H Wade, Carl Hamalainen and Albert S Cooper Jr, Southern Regional Research Laboratory

"The Relationship between the Dyeing Conditions and the Practical Saturation Values of Disperse Dyes on Polyester Fibers"——— J Carbonell, Sandoz Ltd

"Control of Formaldehyde Release from Fabric Finished with Dimethylol Ethyleneurea"———J David Reid, Robert M Reinhardt, Terrence W Fenner, and James A Harris, Southern Regional Research Laboratory

"How Laminating Techniques Affect Corrosion Resistance of Reinforced-plastic Equipment for Textile Chemical Operations"——— S S Feuer and A F Torres, Atlas Powder Co

"APO, A Durable Flame Retardant for Cotton"———George L Drake Jr, Leon H Chance, John V Beninate, and John D Guthrie, Southern Regional Research Laboratory

"Mercerization of Cotton Fibers without Tension"———Henry A Rutherford, J F Bogdan, H K C Woo, and Hibert S Ghosn, School of Textiles, North Carolina State College

"Estimated Costs and In-Service Evaluations of Chemically Modified Cotton Fabrics"———K M Decossas, H L E Vix, and E L Patton, Southern Regional Research Laboratory

"Dyes and Dyeing in the Confederacy"———Sidney M Edelstein, Dexter Chemical Corp

"Preparation and Evaluation of Selected Aliphatic Acid Esters of Cotton Fabric"———Manuel D Cruz—Lagrange, Carl Hamalainen, and Albert S Cooper Jr, Southern Regional Research Laboratory

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1961 National Convention———

PRESIDENT'S ADDRESS*

ELLIOTT MORRILL

Good evening ladies and gentlemen.

It is a pleasant duty and a special privilege for me to come before you tonight to discuss with you matters concerning our Association's affairs. This is an historical occasion as we celebrate the fortieth anniversary of the founding of AATCC. I might dwell on our achievements and accomplishments over these four decades, and I could point with pride and satisfaction to the many milestones which have signified our progress over the years. However, in this fast-moving world in which we find ourselves today, may I ask your indulgence for these few minutes to speak briefly on how we stand today and some of the problems that the future holds for AATCC in the years ahead.

To set the stage and to establish a framework of reference for the thoughts I have on this subject, it might be well to take a brief inventory.

Our membership at the official count on May 1, 1961, exceeded 7,000 for the first time. Our members are located in 46 of the 50 states and in many other countries. We have added two new sections to our organization, now 16 in number, and I am delighted to tell you that our members in the New Orleans and Gulf Coast area are forming a new section. We look forward to giving them a hearty welcome to the expanding family of local sections.

A substantial segment of our membership is active in our committee work. As a technical society, we hold the place of leadership, and through our competence in the technology of textiles and the contributions we have made to the scientific community, we are serving the public in the public interest. This is as it should be, for we are numbered among those societies which have accepted a broad responsibility for advancing the well-being, and in our case, the comfort, the appearance and the satisfaction of Mr and Mrs United States. In fact, every citizen in one way or another is directly or indirectly affected by what our society does and perhaps by what it does not do.

Our technical activities have shown substantial progress. The next AATCC test method to come into being will be designated number 100. The range of our test method coverage has become so extensive that we have re-grouped them into four major categories: identification and analysis, colorfastness, physical properties, and now a new group on biological properties. During the year, we have revised and updated eight test methods, reaffirmed another eight as meeting current test requirements, and raised three tentative tests to the level of standard test methods. Three new test methods are now being processed for approval: Colorfastness to Peroxide Bleaching, Identification of Durable Flame-resistant Finishes, and Quantitative Evaluation of Fabrics Containing an Antibacterial Finish. As you can see, with activity on 22 test methods in the first nine months of 1961, our technical people have been busy.

Great credit is due our Executive Committee on Research, our Technical Committee on Research and to our many research committees for their accomplishments in furthering our Association's technical progress. The many companies supporting the work with both funds and personnel are to be commended for their help and assistance. Whatever the Association achieves is a tribute to the industry which stands behind it, giving support and encouragement.

I think the unique quality of our technical activities is well summarized in one of our recent publications. To quote: "AATCC's committee system is geared to enable men and women in the textile and related industries to solve their technical problems by pooling their knowledge, interchanging ideas and sharing their experience."

With respect to other activities of your Association, the Awards Committees have exercised exceedingly good judgment and discernment in selecting Fred Fortess as the 1961 Olney Medalist and Arthur Thompson for the Harold C Chapin Award. I believe you know that Mr Thompson is relinquishing the treasurership of AATCC, having recently retired from his company. I should like you to know what an outstanding job he has done in guiding our financial affairs during his term of office. He has greatly contributed to the excellent financial position our Association enjoys.

The Intersectional Contest, recently renamed, has been reorganized this year, and I hope that the increased emphasis now placed on this activity will attract papers from many of the sections to the competition at the Atlanta Convention in 1962. We have introduced a certificate of appreciation to be given to those participating on the committees of the competing sections as a means of tangibly recognizing the individual effort and fine work that goes into these projects. I would like to say how much we appreciate having a Canadian paper on the Intersectional Technical Paper Competition program at this Convention and I want to thank those responsible for that excellent presentation.

The *Colour Index* continues in demand and the supplement volume is expected to become available next year. Our *Technical Manual*, now nearly 700 pages, will be an even larger volume as the 1961 edition is released. Marked improvements have been introduced by our editor and his associates on the Publications Committee.

For the first time, the list of textile chemical specialties will include an additional index grouping all products by manufacturers. This will not only be a service to the suppliers but will furnish an additional cross reference for the convenience of the users.

Our sections have offered many fine programs during the year. The New England sections initiated a regional meeting last spring which proved a great success, and the Piedmont Section has scheduled in October the first Southern Textile Research Conference. This shows what can be done at the local level to introduce new and worth-while programs to stimulate interest in regional activities.

I am very pleased that our Canadian members and friends have had an active part in planning and organizing this fine convention.

It is appropriate that our convention theme be "International Textile Technology—Key To Progress". This Convention is further international-

*Presented September 29 during the Annual Banquet, Statler-Hilton Hotel, Buffalo, NY.

ized by having papers from distinguished colleagues in Switzerland and Australia in addition to the Canadian presentations.

Our relationships with our opposite numbers in other countries is becoming increasingly important as the world shrinks. Last May, we had a delegation participate in the meetings of the International Organization for Standardization in England. We expect to have an observer delegation meet with the representatives of the International Federation of Associations of Textile Chemists and Colorists in Zurich next month. We have had a recent visit from the president of the Swiss Association of Chemists and Colorists. Our mutual interest in the *Colour Index* brings us into constant touch with The Society of Dyers and Colourists. These exchanges are beneficial to all concerned and we should continue to increase our cooperative relationships with similar societies in this and other hemispheres. For example, we have had requests from Latin America for Spanish translations of our test methods. There are great advances being made in the technology of textiles on the Continent. We should be thinking how we can channel this information to our members in this country, adding this vast body of knowledge to our own.

In our own country, we value the avenues of exchange of information which have been developed with our sister societies, trade associations and government agencies. These working contacts have broadened our effectiveness and have made our influence felt far beyond the confines of AATCC itself. Conversely, we are benefiting by mutually cooperative efforts with these groups with which we join in the interest of advancing the broad sweep of science and technology.

We have only to look back 15 or 20 years to predict the future: and this is staggering. While developments in synthetics, blends and new dyeing techniques are perhaps not as dramatic as flights to the moon, they have had a significant impact on our industry's manufacturing processes and markets, and on the national economy. Through this transition, AATCC has given form and shape to the technology that has evolved, and this is one of the most important jobs which lies ahead for us. Our Association is in a sense the custodian of an important body of scientific knowledge which we must continue to develop, assemble, coordinate and disseminate. It is up to us to see that this knowledge is brought together in such a manner that its usefulness may be fully recognized by our members as well as those in other industries who are dependent on us.

Our membership is one of many and diverse interests. The challenge to AATCC to serve these varied interests is great. While they are bridged by a common concern for the health and progress of our industry, they must be recognized for the particular fields they represent and the special problems which confront them. The man in the dyehouse, the chemist, the technical sales and service people, the management groups, the educators, the retailers, the commercial laboratories, the government specialists, the finisher and the foreman; these and many others look to AATCC for information and for knowledge. Unless we can communicate that knowledge to them, we are not serving adequately the broad interests of the membership as a whole.

We have the tools for developing and assembling this information through our many committees and our sections; but we must improve the machinery to coordinate and disseminate it.

The question I want to put in your minds tonight is whether we are doing the kind of a job for you that you need to have done. It is my personal opinion that we have both the solid foundations and a great potential and capacity for enlarging this body of technical knowledge which is so essential to us in our struggle to meet the competition of the scientific advances going on around us. I want to emphasize particularly that the practical, down-to-earth application of this technology should be the end-product of our efforts, translated to meet the day-to-day, on-the-job needs of the men and women in our industry. While we have become an acknowledged authority on textile test methods, which are universal in their use throughout the industry, there are many other areas where we can render useful service, and needed service, in providing information at all levels of practical application.

Both the future of our industry and our Association will be cast in the mold of what we do today. It, therefore, becomes important that we relate our thinking to the years ahead and take such steps as will insure our progress in meeting the demands of tomorrow. In the 40 years of our history, we have shaped and reshaped our procedures and our ways of doing things. Yet with all the changes which have occurred, the concept of what this organization is and what it should be, has corresponded with the original views of the founders. The aims and objectives of our Association are sufficiently broad to enable us to grow as our industry grows, to change as it changes, to maintain our position of technical and scientific leadership. This broad base on which we have operated since 1921 is indeed a tribute to the vision and wisdom of our Charter Members.

In closing, I want to express my appreciation personally, and on behalf of this assembly, to the cochairmen of this convention and to the many others who have given their time and talents to making this a successful affair. It should be realized that the Niagara Frontier Section has a little over 100 members, yet it was more than willing, with the help of the Canadians, to undertake this formidable task. I think this is one of the best examples of why our Association has been so successful and has accomplished so much.

Thank you very much.

RHODE ISLAND SECTION FIRST IN '61 ITPC

THE Rhode Island Section's paper, "A Study of the Drying of Cotton Fabric and Its Effect on Subsequent Dyeing and Finishing", was judged to be the winning entry in the 1961 AATCC Intersectional Technical Paper Competition, held last month at Buffalo, NY, during the 1961 AATCC Convention. Second-place honors in the competition went to the Washington Section for its entry "Achieving Accuracy in Measurements of Textiles for Reflectance and Whiteness".

Both papers appear in full in this issue.

First-prize winner: 1961 Intersectional Technical Paper Competition———

A STUDY OF THE DRYING OF COTTON FABRIC AND ITS EFFECT ON SUBSEQUENT DYEING AND FINISHING*

RHODE ISLAND SECTION

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There have been many reports on laboratory investigations concerning heat effects on cellulose, but these have not been related to fabrics in practical plant operations.

Drying methods and equipment at all stages in cotton finishing plants are highly varied both from plant to plant, and also, in relationship to the amount of drying which fabrics of different weights receive within an individual plant.

This paper is a study of the variables in drying by common plant practices and their effect on the subsequent dyeing and finishing. It was found that better control of drying will improve dyeing and finishing results.

INTRODUCTION AND HISTORY

THIS paper deals with a new look at an old process. A search of the literature showed a lack of published information on the variables in drying cotton fabrics by common plant practices, and its effect on subsequent dyeing and finishing.

This sparsity indicated the need for a study of this phase of processing. In the past, unsatisfactory dyeing and finishing results have often been explained as greige goods faults or improper prepare. However, our studies have shown that variable and uncontrolled drying will also give unsatisfactory dyeing and finishing results.

Festooned piece goods in ventilated rooms or towers was the earliest method of indoor drying. In 1845 John Brooks had the idea of stitching the pieces end to end (*1*). This might be called the start of continuous processing and drying. There are several methods now in use, and many articles have been published describing the machines for drying, and useful studies have been made on their efficiency and drying rate (*2, 3, 6, 14, 15, 16*). Generally, these have shown that, at a given temperature, the rate of drying is constant, but the time of drying depends on the water originally held. There are several excellent articles on gin drying (*10, 11, 12*), but the Committee decided not to include gin drying within the scope of this paper.

Several investigators have published their laboratory results concerning the effect of heat on cellulose and cellulose derivatives (*8, 9*). Farquhar, Pesant and McLaren report that heat alone accounted for only part of the degradation of cellulose, but confirm what other investigators report, that air and moisture have a synergistic effect (*7, 13*). This was reported by Wiegerink, who also stated that purified cotton is less resistant to heat (*6*).

Howsmon (*7*) stated that all cellulose and cellulose derivatives have characteristic sigmoid isotherms. The isotherm obtained by placing a dry fiber in an atmosphere of increasing relative humidities lies below that obtained by placing a wet fiber in an atmosphere of decreasing relative humidities. This is the hysteresis effect.

Richter, Herdle and Wahtera confirm that the sorption level of cellulose is greatly affected by the drying history (*9*). Cowen notes that too quick drying will cause a "case hardening" (*17*), and will impair the quality.

EXPERIMENTAL PROCEDURE

Preliminary laboratory work indicated that cotton fabric, wet out in water and then exposed to a hot flatiron, dyed a lighter shade than an equivalent sample not so treated. This effect was demonstrated by varying the moisture content of the cotton fabric, and then exposing it to a flatiron under various conditions of time and temperature.

Fabrics with normal regain moisture content, with 70% moisture, and with 200% moisture were exposed to a flatiron at 300°F for 30 seconds. The samples were then dyed with diazotized and developed dye in a pot. There was no change in the depth of dyeing in the area where the flatiron was applied to the fabric having normal regain moisture. On the other hand, the fabrics having 70% and 200% moisture before drying showed a pronounced lighter shade where the flatiron had been applied.

Additional preliminary work indicated a difference in shade depending upon the mechanism of contact between fabric and flatiron. It was found that, if the flatiron was placed down against the fabric which, in turn, had a backing, the effect was more pronounced than when the fabric was placed upon the surface of the flatiron held in an inverted position. As this latter condition more closely duplicated that encountered in plant conduction drying on cylinders, it was decided to standardize on this procedure for all subsequent laboratory work. Also, in order to minimize possible tension variables, the fabric to be tested was stretched uniformly over a small pin frame, the entire unit then being placed on the heating surface on an inverted flatiron.

All further testing was carried out on a standard 40", 78 × 84, 3.95 yards per pound cotton fabric, the greige-strength data of which are listed in Table I.

The prepare of this fabric was carried out entirely in one plant. The complete lot of the fabric was singed on both sides, desized with an amylo-

*Presented by Herman B Goldstein at the 1961 Intersectional Technical Paper Competition held at the Statler-Hilton Hotel, Buffalo, NY, September 29, 1961

TABLE I
Test Fabric: 40", 78 x 84 3.95
100% cotton

	Tensile strength		
	Max	*Min*	*Average*
Warp	66.5	57.6	62.3
Filling	72.6	59.5	67.2

lytic enzyme, kier-boiled, bleached with sodium hypochlorite, and rinsed. Following the bleach, half of the lot was mercerized at 100°F, using 47° Tw caustic soda. After this, all of the fabric was soured, rinsed, and then was dried for the first time using an Andrews and Goodrich slack dryer at 200°F. On leaving the dryer, the moisture content of the cloth was approximately 5%.

It should be emphasized that the fabric was kept wet from each step in the prepare to the next; it was never dried until the last step, and then only to a moisture content of 5%.

Before attempting detailed drying tests with the prepared fabric, it was first decided to determine the difference, if any, in the contamination of the cloth due to the metal contact of a heated flatiron as compared with a nonmetal heated surface.

A portion of the mercerized test fabric was wet out to a saturated condition (approximately 200% moisture), and exposed to a flatiron at 300°F for various time intervals. Another portion of the same wet-out sample was also exposed under the same time and temperature conditions, except that the heating surface had been Teflon coated. The two samples were then conditioned to normal regain and dyed in a pot with a diazotized and developed dyestuff (Diazo Blue BR, CI Direct Blue 120; developed with beta naphthol, CI Developer 5). The result showed that the same shade change occurred regardless of the type of heated surface.

A second test was run on the uncoated flatiron while the initial moisture content of the fabric was varied. A spectrographic analysis was made of the flatiron-dried samples and also on a blank which had been dyed without any previous flatiron contact. Details of the treatments are shown below:

Sample #1: Blank—wet-out to approximately 70% moisture and dyed.

Sample #2: Fabric wet-out to approximately 70% moisture, pressed 30 seconds with flatiron at 375°F, and dyed.

Sample #3: Fabric wet-out to approximately 200% moisture, pressed 30 seconds with flatiron at 375°F, and dyed.

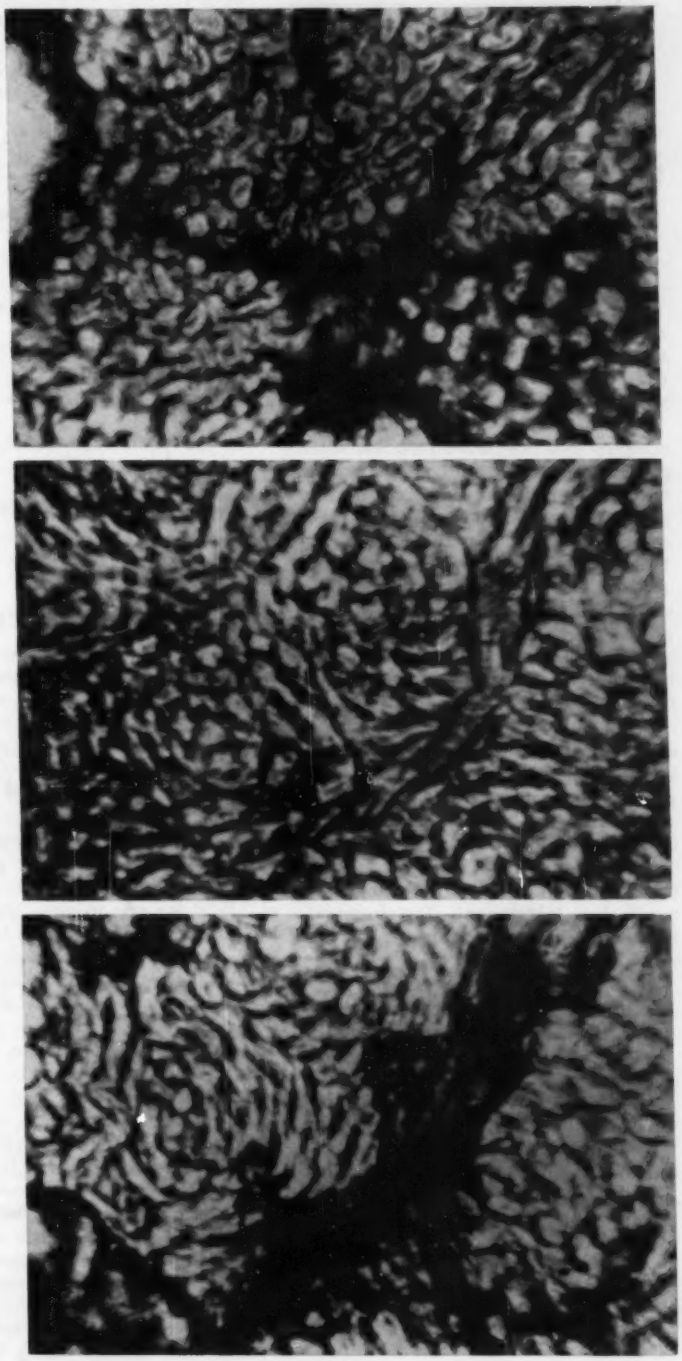

Figure 1

A ten-gram sample of each of the above three samples was ashed, after which one milligram of the ash was mixed with 10 milligrams of CP lithium carbonate. This mixture was then ignited in the arc of a 1.5-meter grating spectrograph. Results of this analysis are shown in Table II.

TABLE II
Spectrographic analysis of dyed cotton fabrics

Cation	*Sample #1*	*Sample #2*	*Sample #3*
Mn ++	1.2 ppm	1.6 ppm	1.0 ppm
Fe +++	5.0 "	4.9 "	5.3 "
Al +++	8.7 "	8.2 "	8.2 "
Ca ++	51.8 "	58.3 "	52.7 "
Mg ++	201.3 "	197.4 "	200.1 "
Cu ++	5.1 "	5.3 "	5.3 "
Cr +++	0.8 "	1.0 "	0.9 "
Ni +	2.3 "	2.0 "	2.0 "
Na +	10.6 "	11.0 "	11.7 "
% Ash	0.053%	0.050%	0.049%

The conclusion reached from these data indicated that no significant metallic contamination had been incurred on the cloth due to contact with the flatiron.

It was also noted on these dyed samples that the flatiron marks, when present, appeared equally distinct on both sides of the fabric. Cross-section photomicrographs were taken of samples #1, #2, and #3 (see Fig 1). In the case of samples #2 and #3, the photomicrographs were taken of the flatiron-treated area. These photomicrographs failed to indicate any difference in dye penetration or fiber characteristics between the heated and unheated areas.

The same three samples were checked quantitatively for the degree of shade change due to excessive drying with a heated surface. Samples 2 and 3 were tested in the areas which had been in contact with the flatiron. These measurements were made with the Color Eye, Model D, manufactured by Instrument Development Laboratories, Inc, and the results are shown in Table III.

TABLE III
Color Eye measurements

	x	*y*	*z*
Sample #1			
Face	11.19	13.97	34.46
Back	11.20	14.00	34.8
Average	11.195	13.985	34.63
Sample #2	*x*	*y*	*z*
Face	12.54	15.44	36.15
Back	12.65	15.50	37.06
Average	12.60	15.47	36.605
Sample #3	*x*	*y*	*z*
Face	12.18	15.02	36.61
Back	12.57	15.42	36.70
Average	12.375	15.22	36.655

The average % difference using y axis shows the following:
Sample #2 10.6% Lighter than sample #1
Sample #3 8.8% Lighter than sample #1

To test the permanency of the excessive drying effect, a piece of the unmercerized test fabric was wet to saturation and divided in half, and each half exposed to the hot flatiron for thirty seconds at a temperature of 350°F. One of the halves was again wet out and then air dried to normal moisture content under controlled conditions. Both pieces were then dyed, and both showed the flatiron image. Thus, a simple rewetting of the flatiron-dried portion was not a corrective measure.

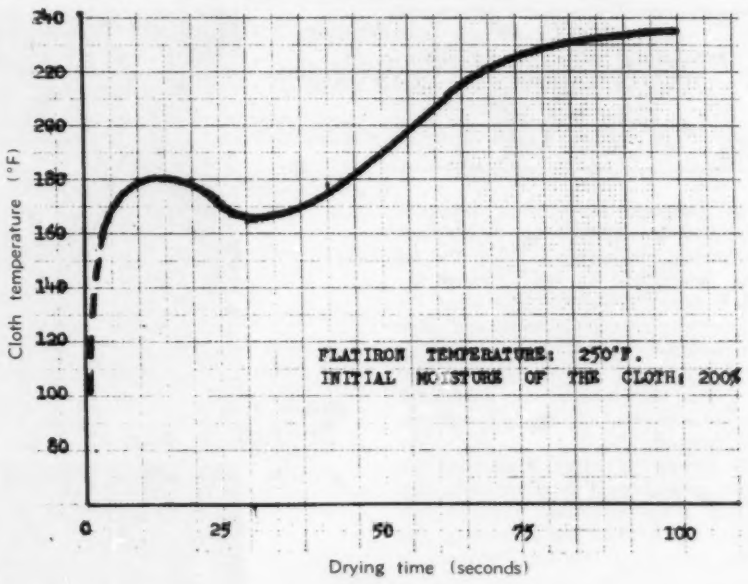

Figure 2
Temperature of the cloth during conduction drying

A second test of permanency was made by mangling a portion of the unmercerized test fabric to moisture content of 70%. A second portion was mangled without pressure to a moisture content of 200%. Both portoins were then exposed to a flatiron at 375°F for one minute. One half of the 70% moisture and one half of the 200% moisture content samples were then mercerized. Following this, all samples were dyed. The dyeings of the unmercerized samples showed a very distinct flatiron image, but there was *no* discernible image on the mercerized portion. This test indicated that mercerizing was one method of correcting this type of drying fault.

A third test was made by wetting out a piece of the mercerized test fabric, exposing it to a hot flatiron, and then dyeing it. This showed a distinct image of the iron, and proved that faulty drying *after* mercerizing will cause dyeing faults.

Fluidity measurements were made on both test fabrics which had been wet-out to 200% moisture and then exposed to a hot iron at 375°F for one minute. Results are shown on Table IV.

Additional tests were made on the flatiron-treated portions of the mercerized test fabrics using constant time exposure and variable temperatures. Results are recorded in Table V.

TABLE IV

Test Fabric	*Exposed to flatiron*	*Post-treatment*	*Fluidity (Cuam Rhes)*
Unmercerized	No	None	2.7
Unmercerized	Yes	None	2.8
Unmercerized	Yes	Mercerized	2.9
Mercerized	Yes	None	2.5

TABLE V

Temp (°F)	*Time of exposure (secs)*	*Fluidity (Cuam Rhes)*
Test fabric	None	3.3
210-220	30	3.0
250	30	2.9
300	30	2.9
325	30	3.2
350	30	3.3
375	30	3.1

The fluidity results showed no trend, and thus indicate that the changes in dyeing characteristics are not due to cellulose degradation.

Some experiments were performed to compare the relative effect of excessive air drying versus excessive drying in contact with a heated metal surface. Portions of the mercerized and unmercerized test fabrics were wet out to several moisture contents. Pieces of each were dried with the flatiron using various conditions of time and temperature. Other pieces of each were air dried in a forced circulation oven, using temperatures up to 400°F. All of the samples were then dyed. It was found that air drying, even under the most strenuous conditions, produced little or no decrease in the depth of shade. On the other hand, the fabrics dried in contact with the heated surface

showed decreased depth of shade even at relatively low drying temperature and/or contact time. Increasing the moisture content before contacting the heated metal surface and carrying the drying to 2% moisture content or less tended to increase the effect of heated metal surface drying.

During these studies, measurements were made of the surface temperature of cloth while it was being dried in contact with the hot flatiron. To do this, the wet cloth was placed on the heated iron in an inverted position, and then a surface pyrometer was immediately placed on the cloth surface. Using this procedure, a temperature curve with time will result, as shown in Figure 2. Although the shape of the curve varies somewhat with the initial moisture content of the cloth and with the flatiron temperature, the general curve characteristics are always apparent regardless of these factors. It would appear that superheating during the initial drying phase is an essential characteristic of conduction drying. As compared with this, when cloth is dried by ordinary air convection drying, the temperature of the cloth surface rises gradually, and without inflection, to the dewpoint of the air in the drier, and remains at that temperature until essentially dry before rising further to the ambient temperature.

In one series of experiments, the mercerized test fabric was wet out to 70% moisture content and then dried by contacting with the flatiron. Half of the contacted area was brushed, and then the entire piece was dyed. In the area exposed to the flatiron, the dyeing was lighter in shade than the portion not exposed to the flatiron. There was no difference between the portion which was brushed as compared with the portion which was not brushed. This indicated that the effect on shade depth is not due simply to an alteration of the fabric surface.

To determine if the differential drying effect of conduction drying was due in some way to residual noncellulose impurities, half of a swatch of flatiron-dried fabric was Soxhlet extracted with chloroform. On subsequent dyeing, there was no difference in depth of shade on the extracted sample as compared with the sample not extracted.

A group of tests was run to determine the effect of drying on subsequent finishing. The mercerized test fabric was wet out, mangled to 70% moisture content, and dried in contact with the flatiron at various times and temperatures. Following the drying, and without reconditioning the cloth, the fabric samples were then impregnated with a conventional, reactant-type creaseproofing agent. Although there were several exceptions, it was found that the flatiron-dried swatches generally showed higher crease-recovery values than did control swatches which were impregnated with normal moisture regain content. Not enough work has been done yet to establish the reason for this improvement in crease recovery; it does not appear to be entirely a factor of higher wet pickup because air drying at elevated temperatures does not cause as pronounced effects.

PLANT TRIALS

Three finishing plants having stainless-steel cans were selected for plant trials for drying test fabrics on their production equipment. The processing conditions are shown in Table VI.

TABLE VI
Processing conditions

	Temp of cans (°F)	*Plant water* — *pH*	*Plant water* — *Hardness ($CaCO_3$) (ppm)*
Plant X	230	7.7	25.07
Plant Y	293	7.6	22.5
Plant Z	250	6.1	9.0

Each plant was given portions of the test fabrics, both mercerized and unmercerized, and was instructed to water mangle one half of each to a moisture content of 70% moisture and the other half to a moisture content of 200%, and dry on cans with a 30-minute stop. The portion stopped on the cans was to be marked.

Plant X reported the moisture content on coming off the cans as well as the moisture regain after conditioning as shown in Table VII.

It is interesting to note that the cloth entering with 200% moisture dried down to a lower moisture content than the cloth with 70% moisture; furthermore, both the 70% and 200% moisture samples of mercerized fabric had less moisture coming off the cans than the unmercerized, but had higher regains.

The dried test samples from all three plants were returned to Plant X, and sewed together in a 1,000-yard roll and dyed with equal parts of CI Direct Green 47 and CI Direct Brown 2, and developed with Developer Z (CI Developer 1).

The samples were dried, and the observations are shown in Table VIII.

Table IX shows a direct comparison of the dyeings from the portions of the fabrics stopped on cans from the three plants.

TABLE VII
Moisture contents

	% Moisture (off cans)	*% Regain (after conditioning)*
Mercerized, 70% moisture before drying	0.68	6.76
Not mercerized, 70% moisture before drying	0.82	5.66
Mercerized, 200% moisture before drying	0.28	6.52
Not mercerized, 200% moisture before drying	0.42	5.78

TABLE VIII
Depth of dyeing of can-dried fabrics

Plant			
X	200% Moisture, mercerized	— shaded	Lighter where stopped on cans
Y	" " "	— shaded	Much lighter where stopped on cans
Z	" " "	— not shaded	
X	200% Moisture, not merc	— shaded	Lighter where stopped on cans
Y	" " " "	— shaded	Much lighter where stopped on cans
Z	" " " "	— shaded	Lighter where stopped on cans
X	70% Moisture, mercerized	— shaded	Slightly lighter where stopped on cans
Y	" " "	— shaded	Lighter where stopped on cans
Z	" " "	— not shaded	
X	70% Moisture, not merc	— not shaded	
Y	" " " "	— shaded	Lighter where stopped on cans
Z	" " " "	— not shaded	

TABLE IX

	Relative depth of dyeing — *Plant X*	*Plant Y*	*Plant Z*
Mercerized, 70% moisture	Medium	Lighter	Medium
Mercerized, 200% "	Heavier	Lighter	Medium
Can Temperature:	X — 230°F	Y — 293°F	Z — 250°F

In general, samples dried in Plant Z showed the most uniform dyeing results, but most samples showed lighter dyeings on the portion of the fabric that rested on the dry cans and darker dyeings on the portion stopped between the cans. Also there was considerable difference in tinctorial value from plant to plant. Plant Y samples, dried on cans with highest temperature, were very mottled, showed the greatest shading and the lightest overall dyeings. All mercerized samples showed more shading than unmercerized samples; samples saturated with 200% moisture before going onto the cans showed more shading than the samples with 70% moisture. The difference in dye value in the samples from the various plants was much greater than expected, considering that the only apparent variable introduced in the processing was in the can-drying temperature. Test dyeings made with the water from the three plants showed no dyeing variations due to the three waters.

A plant trial was made at Plant X with two portions of the mercerized fabric, one of which was water mangled to 70% moisture content, and the other portion mangled to 200% moisture content. Both were dried on the same set of cans with the same temperature setting (250°F). The goods off the cans showed 3.08% and 4.82% residual moisture respectively.

The two pieces were sewed into a jig roll and dyed. The two dyed samples showed some difference in tinctorial value, the one with 200% initial moisture content being slightly darker.

This drying trial was conducted under what might normally be considered regular plant practice. It is evident, however, that the fabric entering with 70% moisture was overdried to some extent when processed under the same conditions needed to properly dry the fabric entering with 200% moisture. This overdrying was sufficient to cause a reduction in tinctorial value.

DISCUSSION OF RESULTS

Moisture, temperature, and time in conduction drying before dyeing can cause shade variations. The electric flatiron is a useful laboratory tool to duplicate plant practice of conduction drying on steam-heated cylinders. One difference in this laboratory method is the fact that all the drying is done on one side of the fabric, while in plant practice, first one side of the fabric is in contact with the heated surface and then the other side until it has completed its progress through the dry-can train. However, our laboratory dyeings showed equal dye shadings on both sides of the fabric and good duplication of results in all laboratories.

A cotton fabric with normal regain moisture is not affected when pressed with a hot flatiron (375°F) for a period much longer than any common plant process, but a fabric wet out and extracted to as low as 70% moisture content is very sensitive to a flatiron heat of 300°F, and will show less dye absorption.

Spectrographic analysis proves that this is not due to metal contamination, and this is substantiated by covering the flatiron with Teflon. Photomicrographs show that the fibers exposed to flatiron heat were as well penetrated with the dyestuff as the fibers not exposed to flatiron heat.

An increase in the carboxyl content is generally reflected in a fluidity rise, but our fluidity tests (cf Tables IV and V) show no increase; therefore, no cellulose degradation was indicated.

It is possible that dyestuffs are a more sensitive indicator than chemical tests. The fact that the flatiron image was not removed by rewetting and, in fact, proved more resistant to rewetting, might be called case hardening, as described by Cowen (*17*). In conduction drying, the temperature of the fabric's surface in contact with the heated element will be higher than the wet-bulb temperature of the surrrounding medium. This higher temperature increases the vapor pressure, which, in turn, creates rapid drying. High temperature in the presence of moisture reduces the hygroscopicity of the cellulose, and increase crystallization. It is thought that the lower sorption capacity of both moisture and dyestuff, and the crystallization, are caused by increased hydrogen bonding. The behavior with creaseproofing agents tends to confirm this. Mercerization proved one way of removing a flatiron image before dyeing. This seems to indicate that swelling the fiber by mercerization effects decrystallization and causes corresponding rise in sorption values.

Most of the plant trials were done under exaggerated conditions, and exaggerated results were obtained, but good correlation with laboratory tests. The three different plants selected have dry-can temperatures of 230°F, 250°F, and 293°F, and used both mercerized and unmercerized test fabrics. The fabrics dried at 230°F gave the heaviest shade, while the fabrics dried at the plant with the highest dry-can temperature (namely, 293°F) not only dyed lighter, but were extremely mottled. All the dyeings from this latter plant showed much lighter dye shades on the portions that stopped on the cylinders.

In the one plant trial conducted under practical conditions, it was proved that overdrying on cans will cause loss in tinctorial value.

During the course of this work, it was thought that the dyes might be sensitive to water hardness, but it was proved that the difference in hardness of the water in the three plants had no effect on the dyes we used. With these dyes, the drying conditions did affect the dyes in evenness of dye shade and tinctorial value.

SUMMARY

The subject of heat and moisture on cellulose is too broad to be covered in one paper. It was found to be so broad that this study was confined to a narrow area. This paper is really a new approach to an old subject. The literature reveals that a tremendous amount of research has been done in laboratories on the effect of heat alone, heat and moisture, sorption and desorption of cellulose and cellulose derivatives, with general agreement among observers.

It is amazing that so many facts on the mechanism of drying and sorption have not been translated into plant practice. Even in the narrow area of this study, it was found that the end results are affected by the drying history of a fabric. What is most needed is more accurate data on drying equipment, with better control. At present, most equipment is operated without proper consideration of the dangers of overdrying. For example, speed and temperature are not adjusted for fabrics and construction, this being particularly true in drying multiple strands simultaneously. All laboratory reports, including this study of drying, prove that overdrying is detrimental. The data presented here show that best dyeing results will be obtained by not drying a fabric to less than the normal regain moisture content during any of the steps prior to dyeing. This is particularly true when can drying is employed.

This work clearly indicates that proper drying, its effect on subsequent dyeing and finishing, and the

(*concluded on page 54*)

Second-prize Winner: 1961 Intersectional Technical Paper Competition———

ACHIEVING ACCURACY IN MEASUREMENTS OF TEXTILES FOR REFLECTANCE AND WHITENESS*

WASHINGTON SECTION

INTRODUCTION

METHODS for measuring the whiteness and tristimulus reflectances of white and undyed textile materials are being used in a number of ways. Raw materials such as cotton are being measured to indicate whiteness potential developable by bleaching. Synthetic fibers and fabrics are being measured as an aid to the control of product uniformity and for determinations of fluorescent brightener content.

Turning from textile raw materials to processing, we find measurements being used to evaluate traditional bleaching processes and fluorescent dyes. In the field of textile finishing, there is another large area of interest in whiteness and one of its components, yellowness. Here measurements are used to determine loss of whiteness from resin, heat, and other agents and treatments used in the finishing processes.

It is with textile products in service, however, that measurements of whiteness and tristimulus reflectances are most widely used. The efficiency of detergents on both natural and artificial soils is widely measured. Soil redeposition during laundering and cleaning is also measured. Not only the detergents, but the laundering and drycleaning equipment and process, and their effects on textile materials are also subject to frequent optical evaluation. Finally, yellowing from scorching, perspiration and the increasing variety of chemicals which textile materials encounter in service is also subject to frequent measurement.

Because there is such a wide variety of application, it is not surprising to find many textile workers interested in improving the reliability of measurements of tristimulus reflectance, yellowness, and whiteness. It is because of this broad area of interest that the Washington Section undertook to determine what is needed to improve the reliability of color measurements of white and near-white textile materials.

*Presented by Richard S Hunter at the 1961 Intersectional Technical Paper Competition held at the Statler-Hilton Hotel, Buffalo, NY, September 29, 1961

COMMITTEE

RICHARD S HUNTER, chairman & speaker
Hunter Associates Laboratory, Inc

MARY B SPICER
Hunter Associates Laboratory, Inc

LYMAN FOURT
Harris Research Laboratories

GRAND EDWARDS
Harris Research Laboratories

MARGARET S FURRY
U S Dept Agriculture, Textile & Clothing Section

KATHERINE TAUBE
U S Dept Agriculture, Textile & Clothing Section

NED HOPPER
National Institute of Rug Cleaning

FRED LOIBL
National Institute of Drycleaning

WERNER PELS
National Cotton Council

ISADORE NIMEROFF
National Bureau of Standards

Before measurements of whiteness and bleaching progress become standard in the textile industry, it will be necessary to assure that different laboratories and different instruments used for these measurements are able to agree. The study undertaken by the Washington Intersectional Technical Paper Competition Committee has sought the answers to three questions: 1) How well do different instruments agree in measurements of reflectance and whiteness? 2) To what extent are spectral and photometric differences between these instruments the causes of disparities in results? 3) What precautions and techniques in specimen preparation and handling are needed to attain repeatable whiteness and reflectance values? The Committee has compared measurements of a variety of textile specimens from 12 different instruments in the Washington, DC, area. Six types of instruments were used in eight different laboratories. A special series of permanent ceramic standards was used to identify spectral, geometric, and photometric differences between instruments. Blue reflectance values of brightened specimens varied importantly with blue-filter differences, but otherwise instrument differences contributed little to the disparities which occurred.

OPTICAL NATURE OF WHITENESS

In a recent paper (*1*), Hunter defined a white surface as one which appears white when seen in its normal surroundings. He noted that whites were characterized by high reflectance throughout the visible spectrum. A white is differentiated from a bright mirror-like metal, which also has high reflectance throughout the spectrum, by the fact that light reflected by the white is diffused uniformly in all directions.

In a second paper (*2*), Hunter has shown that, in general, whiteness and its attributes can be adequately measured by green and blue tristimulus reflectances. Green or luminous directional reflectance is measured with a spectral weighting known as the luminosity function. This function covers the whole visible spectrum but has a maximum in the green region. The daylight (Illuminant C) luminosity function is shown in Figure 1. The blue or Z tristimulus function is limited to the blue region

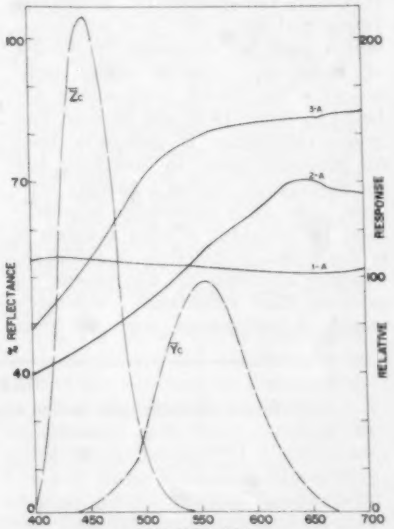

Figure 1

Green ($\bar{y}_c$) and blue ($\bar{z}_c$) functions of standard observer together with gray (1-A), tan (2-A) and cream (3-A) centroid panels.

of the spectrum. The daylight, Z function, is also shown in Figure 1.

Most white materials are naturally yellowish. Even after adjustment with bluish dyes or pigments, the white materials encountered in everyday life are most likely to be yellowish, sometimes bluish, less often greenish or pinkish.

Not only are pinkish and greenish whites less prevalent than yellowish and bluish ones, but there is conflicting evidence on how to assess properly the pink-green chromatic dimension in whiteness measurement. A study of commerical preferences for white textiles, paints, and papers reveals that, where there is a choice between pinkish and greenish tints in white, pink is usually (though not always) preferred. Because the role of the pink-green dimension of chromaticity in whiteness is generally small, and has not been quantitatively assessed, it seems feasible to ignore this chromatic dimension in whiteness measurement.

Chromaticity departure from neutral in the yellow and blue directions is measured by differences between green and blue (G and B) tristimulus reflectances (*2*). The pink-green dimension involves a third tristimulus reflectance, which may be amber (A) or CIE—X, depending on the instrument. If the third dimension is ignored, a reflectometer with only green and blue tristimulus filters is adequate for whiteness measurement.

Measurements of green reflectance (G), blue reflectance (B), yellowness (measured by G-B) and whiteness, which may be measured by 4B-3G, all have their uses in textile technology. The chief applications are listed in Table I. It will be seen that green reflectance is generally used for materials prior to bleaching and for detergency studies involving artificial soils. Blue reflectance is widely used in bleaching studies because it is the primary function of a bleach, whether chemical or fluorescent, to increase blue reflectance. Measurements of yellowness seem to have their widest application in studies involving surface treatment and service damage to textiles.

Whiteness, if written:

$$W = G - 4(G—B)$$

will be seen to weight the effects of luminous reflectance and freedom from yellowness by 1 to 4. This formula for whiteness, which is more commonly written:

$$W = 4B - 3G,$$

is finding widespread use for measurements of overall color acceptance of white materials.

Although it is generally known that the eye can detect reflectance differences as small as 1% under ideal conditions, it is not so widely appreciated that it can detect smaller differences in yellowness (*3*) or G-B. The whiteness equation suggests that this is so, for the G-B reflectance differences receive four times the weight of reflectance alone. If instruments are to equal the eye in performance, they need only measure G to 1%, but they must measure G-B to 0.25%.

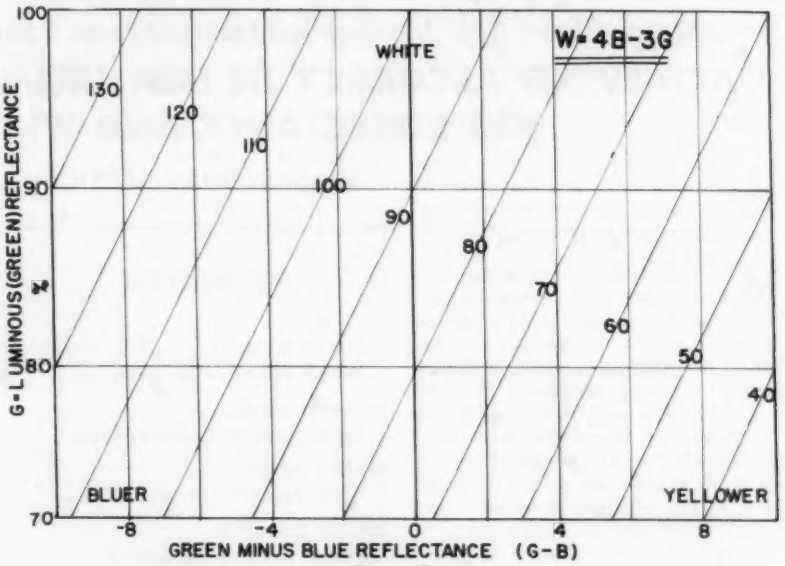

Figure 2
Reflectance (G), yellowness (G-B) chart with whiteness contours (W=4B-3G).

Figure 2 is a diagram of the type coming into general use for plotting results of whiteness measurements. Yellowness, measured by G-B, is plotted horizontally, green (luminous) reflectance is plotted vertically, and straight line contours for W = 4B-3G are plotted obliquely. It will be seen that light colors are at the top, dark ones at the bottom, yellowish colors at the right and bluish colors at the left of this diagram. According to the 4B-3G equation, bluish colors are whiter than neutrals of the same reflectance. Though logic may argue that this should not be so, jury panels and studies of customer whiteness preferences reveal that the preferences for bluish whites indicated in Figure 2 is a correct assessment of commercial practice.

SOURCES OF MEASUREMENT DIFFERENCES

Differences between results on the same specimens from different instruments can arise from either differences in:

standards,
instruments, or
specimen preparation and presentation.

To eliminate the standards as a source of discrepancy, nearly identical standards were calibrated on one instrument against one standard reflectance panel.

Below are tabulated the points of

TABLE I
Terms, symbols, and textile applications of quantities studied

Terms	*Symbols and equations*	*Applications*
Luminous directional reflectance	G (also Yc,Rd)	Detergency studies using artificial soils. Whiteness potential before bleaching
Blue reflectance	B (also Zc)	Whiteness potential after bleaching. Bleaching progress
Yellowness	Yel = G-B [(G-B)/G also used]	Degradation from resin treatment, heat, perspiration, chemical attack and other treatments. Detergency studies using natural soils.
Whiteness	W = 4B-3G	Overall color acceptance of white materials.

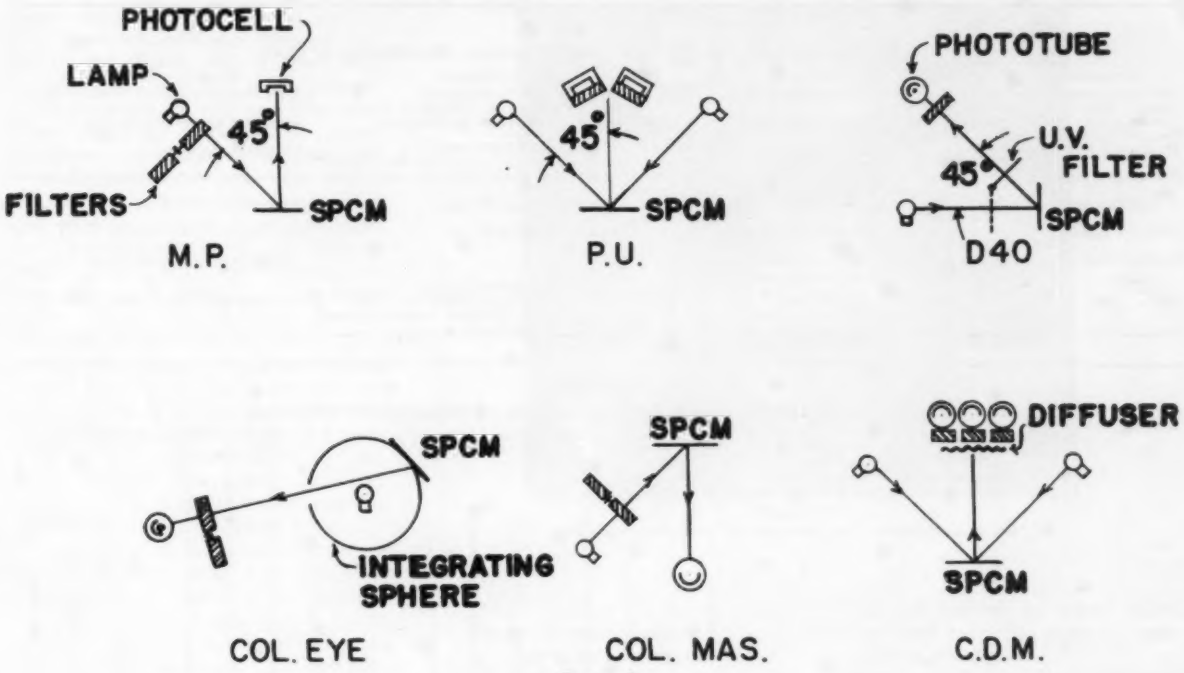

Figure 3
Block diagrams of instruments used.

difference which may arise between specimens and the differences which may be introduced in specimen presentation for measurement. It should be pointed out in connection with the differences that many of these are as likely to be found when comparing instruments of the same model as when comparing instruments of different models.

Sources of Measurement Differences

Differences Between Instruments:

Spectral: Spectral differences in source-filter-photodetector combinations
With fluorescent specimens only:
Position of filter ahead of, or behind specimen
Color temperature differences in light source

Geometric: Differences in directions of incidence and view
Differences in relative sizes of specimen areas illuminated and viewed

Photometric: Differences in photometer accuracy and precision
Erroneous inclusion of stray light or photodetector dark current

Differences in Specimen Presentation for Measurement:

Differences in specimen mounting:
In flatness and freedom from wrinkles
In presence or absence of cover glass
In specimen compression or tension
In specimen thickness and backing

Differences in specimen orientation:
In orientation of warp and fill
In randomization of fibers
In pile lay

PLAN OF PROJECT

The present project was undertaken because problems of interlaboratory agreement lend themselves to committee study and because the chairman has been attempting recently to develop a series of panels with which to check the accuracy of tristimulus instruments.

A variety of tristimulus instruments suitable for measurements of green and blue reflectance are available in laboratories of the Washington area. The 12 different instruments and eight different laboratories participating are identified in Table II. It will be noted below that data from only 11 of these instruments were intercompared because one operator failed to follow instructions. Block diagrams of important features of the six models of instruments used are shown in Figure 3. All were tristimulus reflectometers or color-difference meters with green and blue filters designed for measurements of daylight reflectance. The actual illuminant in each instrument was incandescent lamplight. Following the technique developed by Hunter (4) twenty years ago, lamplight to daylight correction was built into the various filters at the same time as correction for photodetector sensitivity. As a consequence, the resultant products of source energy, filter transmission, and photodetector response are closely similar to the y_c and z_c functions respectively. Most of the instruments also have either x_c or amber tristimulus filters, but these were not used during the present study.

Figure 3 shows which instruments have the ultraviolet-absorbing filter beyond the specimen so that they respond to fluorescent brighteners. It will be seen that three types of instruments [Photometric Unit, Color Eye and Color Difference Meter (7)] respond to fluorescent brighteners, two [Multipurpose (5) and Colormaster (6)] do not, and one [D40 Reflectometer (2)] can either include or exclude brightener contributions. It will also be seen that five of the instruments have 45°0°, or the equi-

TABLE II

Committee members, laboratories, and instruments participating in study

Committee member	*Laboratory*	*Instrument*	*Normal Use of Instrument*
Richard S Hunter, *Chairman*	Hunter Associates Laboratory	Hunterlab D40 Reflectometer Hunterlab D25 Color Difference Meter	Instrumental studies of all materials
Mary B Spicer	McLean, Va		
Lyman Fourt Grant Edwards	Harris Research Laboratories Washington, DC	Hunter Multipurpose Reflectometer	Detergent and textile research
Margaret S Furry	Textile & Clothing Laboratory, USDA, Beltsville, Md	Hunterlab D40 Reflectometer Gardner Automatic Color Difference Meter	Detergent evaluation
Katherine Taube	Housing & Equipment Laboratory, USDA, Beltsville, Md	Gardner Automatic Color Difference Meter	Washing machine performance evaluation
R Ned Hopper	National Institute of Rug Cleaning Bethesda, Md	Gardner Photometric Unit	Soil removal on carpets
Frederick Loibl	National Institute of Drycleaning Silver Spring, Md	Gardner Photometric Unit	Soil removal in drycleaning
Isadore Nimeroff	National Bureau of Standards Washington, DC	Color Eye Colormaster Gardner Color Difference Meter	Instrumental studies of all materials
Werner Pels	National Cotton Council Washington, DC	Hunterlab D25 Color Difference Meter (Instrument at National Canners Assoc)	Processed food color measurement

TABLE III

Panles, textile specimens and the chief sources of measurement difference

		Instrument differences								*Specimen presentation differences*						
		Spectral				*Geometric*				*Mounting*				*Orientation*		
		GREEN	BLUE	Source filter photo-cell differences	Color temperature of illuminant	Position of filter relative to spcm	Beam-direction differences	Translucency light losses	Photometer scale errors	Specimen flatness	Presence or absence of cover glass	Specimen compression and tension	Specimen thickness and backing	Specimen orientation	Randomization of fibers	Pile-lay differences
Standardized panels																
	Tan centroid relative to gray standard	x														
	Cream centroid relative to gray standard		x													
	Light gray relative to white standard								x							
	Dark gray relative to white standard								x							
	Foam plastic relative to white standard							x								
Textile specimens																
Flat	Greige 80 x 80 cotton (with and without glass)									x	x			x		
	Wool (with and without cover glass)					x				x	x					
	Bleached 80 x 80 cotton (with and without glass)									x	x			x		
	Cotton carpet (with and without cover glass)									x	x	x				x
Bulk	Nonwoven behind glass							x				x				
	Terry behind glass															x
	Nylon fibers compressed between glass														x	
Fluor	Brightened 80 x 80 cotton (behind glass)					x								x		
	Brightened knit cotton (behind glass)					x								x		
	Brightened nylon organdy (behind glass)					x								x		
Factors not studied					x		x						x			

valent 0°45° geometry; one has a diffuse, 40° geometry.

The Committee chairman recently selected a series of panels for the purpose of detecting significant differences between tristimulus instruments. It was the plan of the present project to first circulate these panels to see what differences there were between the instruments being compared. Next, a variety of textile specimens was circulated to determine how well the various instruments agreed when operated with centrally calibrated standards and with a uniform set of instructions. It was hoped that the panel results from the different instruments would predict errors to be found on specific types of textile specimens. Sources of disparity, which can thus be identified and measured, can be eliminated.

The test panels, which were circulated first, were designed to measure significant spectral, geometric and photometric differences between the various instruments. Spectrophotometric curves for the three ceramic panels used for the centroid test are shown in Figure 1 along with the y_c and z_c functions. The reference panel is a gray with nearly flat spectral curve. To test the spectral centering of the y function, a tan panel of nearly the same green reflectance is measured against the gray. The error in measurement of this tan panel, if plus, indicates overweighting in the yellow direction; if minus, indicates overweighting in the blue direction. The third centroid panel is cream colored and of nearly the same blue reflectance as the gray. It is used in the same way to evaluate the blue source-filter-photocell function.

In addition to the medium gray used for the centroid test, there is a white ceramic plaque, which was also used as standard for the fabric measurements, and a dark gray. An intercomparison of these three gray panels of widely different reflectances reveals whether the photometric scale of an instrument is accurate. The white and light gray plaques span the reflectance region of interest for whites and near-whites. Readings of the dark gray are useful because they detect stray light, grid leakage, and other errors which are most readily found at the bottom of the reflectance scale.

One panel is designed to disclose a geometric source of instrument disparity. This is susceptibility to loss of light from translucent specimens behind the specimen window edges. For this test, a block of white foam plastic into which light penetrates an inch is compared with the white porcelain enamel. The translucency of the plastic specimen is greater than that of most pile-fabric and fiber

specimens met in the textile industry. Therefore a comparison of the translucent foam plastic with the opaque white standard gives a magnified measure of any window-edge losses likely to occur when textile translucent specimens are measured for reflectance or color.

Table III lists the standard panels and specimens which were circulated for the present study. It also lists by column headings the sources of measurement disparity tablulated above. They are separated into instrument sources and sources of disparity from specimen presentation. It will be seen in this table that not only the standard panels but textile specimens were selected for the purpose of identifying sources of disparity. Figure 4 is a photograph of some of the panels and specimens studied during the present project.

Four common types of fabric were measured twice, first with and then without cover glass. These were a standard square weave cotton greige goods, a bleached cotton of the same type, a wool flannel, and a cotton carpet. Three rather bulky materials were sandwiched between cover glass to minimize the window-edge error. These were a nonwoven gauze, a terry, and a wad of nylon fibers randomly oriented. The last three fabrics chosen were optically brightened whites. One was another square weave cotton, one a knit cotton, and the last a nylon organdy. A nylon satin was circulated but it was so lustrous that it could not properly be measured by the techniques employed for the other specimens.

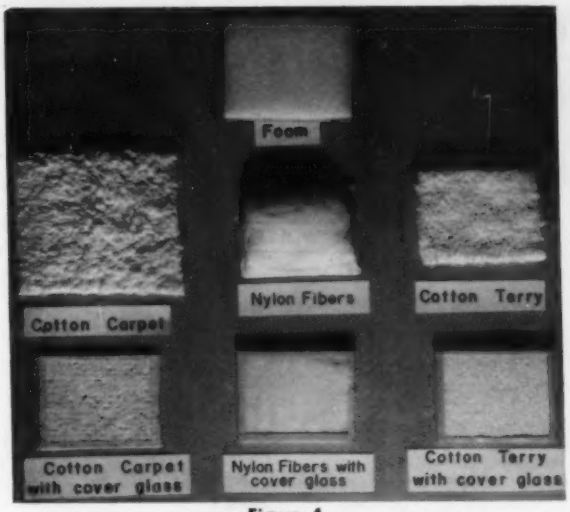

Figure 4
Bulky specimens in mounted and unmounted forms

INSTRUMENT MEASUREMENTS

As indicated above, the single set of standardized panels was first circulated. The instructions which went with these follow:

"If you have a tristimulus reflectometer, please read green and blue reflectances. With the Color Difference Meter, read, if possible, Rd and b. If your instrument does not have the Rd scale, read L and b. Read the specimens in two groups:

Group I
- No. 1 Light gray (use as standard)
- No. 2 Tan
- No. 3 Cream

Group II
- No. 4 White glass (use as standard)
- No. 5 White
- No. 1 Light gray
- No. 6 Dark gray
- No. 7 Foam
- No. 8 Textile specimen, mounted between cover glasses
- No. 9 Textile specimen—measure with and without ultraviolet contribution if possible

Insert the light gray tile and adjust the instrument to give the values assigned it. Read specimens 2 and 3; then repeat readings on the three tiles in the reverse order, finishing with a second pair of readings on specimen No. 1.

Next go to White No. 4. Restandardize the instrument to read this panel correctly, then read Nos. 5, 6, etc. Rotate textile specimens 90° between readings. Again take a second set of readings in the reverse order, finishing with a second pair of readings on specimen No. 4."

It will be seen that two textile specimens were flattened for this first series of measurements. However, since the findings with these two cottons, one brightened and one not brightened, were substantially those from the latter test, they are not reported below.

For the fabric study, two ceramic standards, one white and one gray, and a separate set of fabrics was prepared for each cooperator. All the fabric specimens of one type were cut from the same piece of goods. The data sheet carried instructions which read as follows:

"Standardize instrument on white tile values (without cover glass). Read gray tile and #1 fabric, #3 wool, #8A unmounted, #11 carpet all backed by white standard and held flat with 4- to 5-pound weight.

Mount cover glass. Take two readings on white and gray tiles and unmounted fabrics.

Remove cover glass and read mounted samples as above.

Read the standard at the end, then Take a second set of readings as above, in reverse order, finishing with white standard and no cover glass.

Where possible, measure samples with optical brightener both with and without ultraviolet.

Compute averages for each specimen. If, as the result of drift, the average of the initial standard differs from its assigned or True Standard value, *multiply* all the averages by the factor which will convert the standard average to its Assigned Standard value, eg:

$$\text{Assigned Value } 89.0 \quad \text{Mean } 89.2 \times 76.3 = 76.1$$

For the computations, you use only the Corrected Mean values."

Though they should have, these instructions neglected to tell the operators to rotate each textile specimen 90° between first and second sets of observations. However, most operators did rotate specimens as they had with the first study.

REDUCTION OF DATA ——— From each of the reflectometers, values of G and B were read. From the color difference meters G = R_d could be read in some cases. In other cases $L = 10\sqrt{G}$ was read.

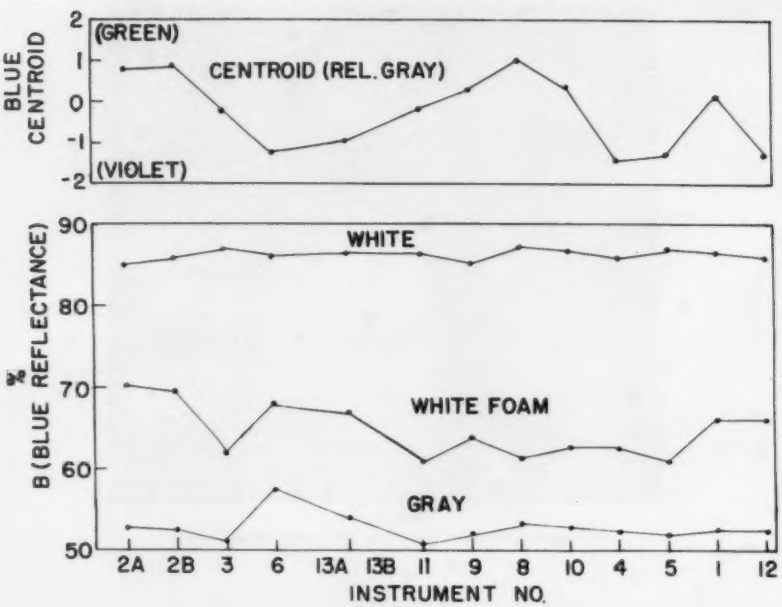

Figure 5
Blue centroid and standard-panel values from different instruments.

None of the color difference meters read B directly. Instead they gave values of b = f_0(G—B). To convert from b to blue reflectance, a nomograph was used.

After mean readings of G and B were computed and checked for all instruments, these were corrected for each instrument by the multiplication factors giving the assigned values for the white standard. For specimens exposed without cover glass, the standard readings without cover glass were used. Where specimens were mounted behind cover glass, the readings of the white standard behind cover glass were used.

Results from the different specimens with the different instruments were first tabulated graphically by instrument to permit visual inspection. The centroid, gray panel, and foam panel data for the standard panels were plotted for each filter on a separate sheet. Figure 5 shows these standard-panel data for the blue filter. Separate graph sheets were made for 1) the unmounted flat fabrics, 2) the flat fabrics mounted behind glass, 3) the bulky specimens behind glass, and 4) the brightened fabrics behind glass. Figure 6 shows the blue reflectances of the three brightened fabrics. Closed points are used to indicate the inclusion of fluorescence brightener contribution; open points are used to indicate its elimination by filter ahead of the specimen.

Visual examination of the nine graphs, only two of which are printed here, revealed considerable variability between instruments but little that was systematic. Visual inspection of the plotted data led to the rejection of data from one instrument because it was badly and erratically out of line with the others. Inquiry at the laboratory where this instrument was used revealed that the operator failed to follow instructions and never removed the built-in cover glass. This operator merely added the present cover glass when it was called for and took it off when the cover glass was supposed to be removed.

The one relationship discovered by visual inspection was that between blue centroid value and blue reflectance measured with brightener included. It will be seen by comparing the centroid line in Figure 5 and the solid lines in Figure 6 that where the centroid line dips, the blue reflectance curves rise. In other words, the more violet the blue filter, the higher the blue reflectance with brightener.

Averages of the remaining values of green and blue reflectance were computed; then, as measures of dispersion, values of the standard deviation, sigma, were calculated. These calculated average reflectances and sigmas are shown in Table IV.

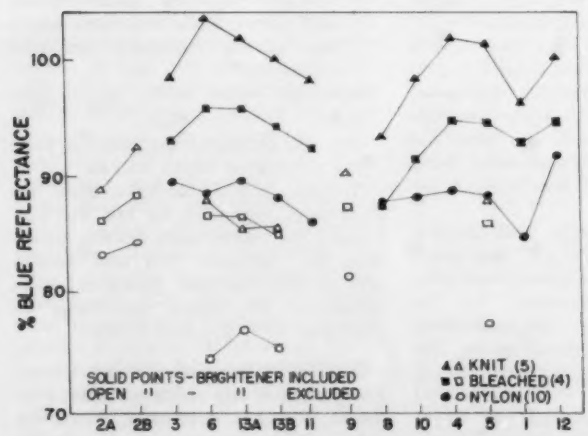

Figure 6
Blue reflectance of brightened fabrics measured by different instruments.

TABLE IV
Average reflectances, and disparities between instruments expressed by standard deviation, sigma

	Green reflectance Average	Sigma	*Blue reflectance* Average	Sigma
Panel study				
Centroids (rel lt gray)	54.3	0.5	51.7	1.2
Light gray (rel white)	54.6	1.0	53.2	1.7
Dark gray " "	5.7	1.3	7.5	2.8
Foam plastic (rel white)	67.6	3.2	64.6	3.2
Textile study (cover glass omitted)				
Light gray panel	53.2	0.8	51.9	1.4
Greige 80 x 80 cotton	72.6	1.3	60.0	2.0
Wool flannel	82.5	1.7	69.4	4.3
Bleached 80 x 80 cotton	86.4	1.6	80.1	2.5
Cotton carpet	78.1	2.5	74.4	3.1
Cover glass installed				
Light gray panel	50.8	0.7	49.9	1.3
Greige 80 x 80 cotton	71.6	0.6	58.4	1.7
Wool flannel	81.0	0.7	67.0	3.6
Bleached 80 x 80 cotton	86.8	1.5	80.9	1.3
Cotton carpet	80.1	1.3	75.9	1.4
Bulky specimens behind glass				
Nonwoven	83.8	0.7	82.2	2.5
Terry	90.3	1.2	86.9	1.0
Nylon fibers	78.0	1.3	74.8	1.9
Brightened specimens behind glass				
80 x 80 cotton: br incl	84.7	1.3	93.5	2.2
" excl	84.7	0.8	85.7	0.7
Knit cotton: br incl	89.0	1.5	98.9	4.4
excl	89.7	1.9	88.5	2.3
Nylon organdy: br incl	75.2	1.5	88.2	1.8
" excl	75.8	1.3	79.1	3.6

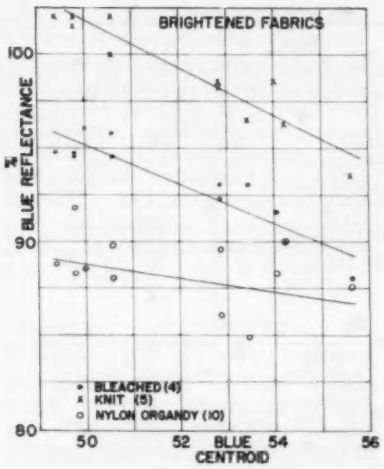

Figure 7
Relationship of blue centroid to blue reflectance of brightened fabrics.

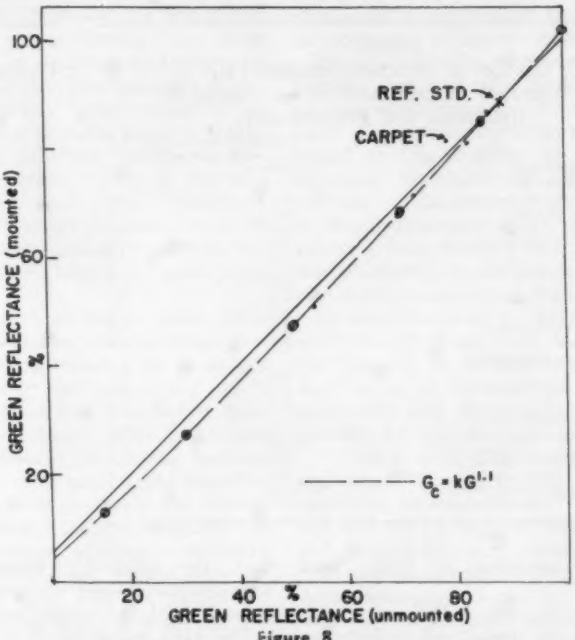

Figure 8
Curved reflectance scale resulting from use of cover glass.

ANALYSES OF RESULTS

FLUORESCENT BRIGHTENERS

——As noted above, it was only in measurements of the blue reflectance of brightened specimens that any relations between panel tests and specimen results could be established. In Figure 7 are plotted the blue reflectances against the blue centroid values for brightened specimens previously shown in Figures 5 and 6. It will be seen that of the three brightened specimens, No. 5 shows both the highest blue reflectance and the greatest change of reflectance as a function of blue centroid. By contrast, the nylon organdy shows the smallest values of blue reflectance and the smallest change.

It must be remembered that the spectral centroids refer to the combined spectral product of source-filter and photodetector. No data were obtained on the color temperatures of the light sources used in the different instruments, although it is known that all are in the range, 2900°K to 3300°K. Because markedly different filters and photodetectors are used in the different instruments, it is not safe to assume any relationship between blue centroid and light source color temperature. Since percentage of ultraviolet increases rapidly with increasing color temperature, it is reasonable to suppose that differences in source color temperature are responsible for some of the scatter of points about the lines shown in Figure 7.

Though illuminant color temperatures were not measured, it is quite certain that differences in filters and photo detectors were responsible for a major part of the blue centroid differences. It is, therefore, reasonable to ask why the blue reflectances with brightener contribution are not definitely a function of blue centroid. The answer lies in the fact that the brighteners preferred by the market are violet in hue and have their maximum emissions near 435 mμ which is on the violet side of the center of the blue tristimulus function. It is almost certainly for this reason that the tristimulus functions with violet centroids give the highest brigtener reflectances. It may be noted in this connection that the brightened nylon organdy was more greenish than the other two specimens. This greenish cast would suggest that its brightener peaked at a somewhat longer wavelength than the others. If this is so, one would expect less of a change of blue reflectance with blue centroid. This diminished effect is, in fact, shown in Figure 7.

Cover glasses and glass containers are widely used for color measurements of textiles to provide the flat planes necessary for precise reflectance measurements. In the present study, lantern slide cover glass about one millimeter thick was used.

In connection with the blue reflectance measurements of brightened fabrics, a test was performed to see if cover glasses, because of their ultraviolet absorption, diminish fluorescence contribution to reflectance. The two 80 × 80 cotton fabrics, one brightened and one not brightened, were measured for blue reflectance relative to the white standard, once with and once without cover glass. The following were obtained:

	Blue reflectances	
	Unbrightened	*Brightened*
Without cover glass	79.1	90.9
Behind cover glass	79.5	93.4

It appears from the foregoing that the cover glass increases rather than decreases the blue reflectance of fluorescent specimens. Actually, the apparent increase is probably due to the comparison effect described below. It is apparent, however, that the cover glass causes negligible loss of fluorescence contribution.

It will be seen that the first two groups of data for textile specimens in Table IV refer to the same four specimens first without, and then behind cover glass. From the figures for standard deviation, it will be seen that use of the cover glass greatly improves the precision. (The wool discrepancies in B should be ignored, for a reason explained below.)

It will be seen from the reflectance values in Table IV that the reflectances behind cover glass are generally less than those without. Actually, the introduction of cover glass makes the reflectance scale nonlinear because of interreflections between glass and specimen. If the total diffuse reflectance of the cover

TABLE V

Changes in reflectance measured by one laboratory as each specimen was rotated 90° (Hunterlab D40 Reflectometer)

Specimen	Reflectance change with rotation (%) Green	Blue
Cover glass omitted		
Light gray panel	0.1	0.4
Greige 80 x 80 cotton	0.2	0.6
Wool flannel	0.9	1.5
Bleached 80 x 80 cotton	3.0	4.4
Cotton carpet	3.1	4.0
Cover glass installed		
Light gray panel	0.0	0.3
Greige 80 x 80 cotton	0.4	0.3
Wool flannel	0.3	0.4
Bleached 80 x 80 cotton	3.1	4.9
Cotton carpet	0.4	0.8
Bulky specimens behind glass		
Nonwoven	0.5	0.7
Terry	1.1	1.4
Nylon fibers	2.4	1.9
Brightened specimens behind glass		
80 x 80 cotton: brtnr included	2.6	3.1
brtnr excluded	2.6	3.7
Knit cotton: brtnr included	5.0	4.6
brtnr excluded	5.0	5.1
Nylon organdy: brtnr included	1.9	1.5
brtnr excluded	1.9	1.5

TABLE VI

Changes in reflectance of one specimen (80 x 80 bl cotton) as specimen was rotated 90° in each laboratory

Lab No.	Instrument	Unmounted specimen Green	Unmounted specimen Blue	Specimen behind glass Green	Specimen behind glass Blue
2a	Multipurpose Reflectometer	4.8	5.1	0.2	0.2
2b	" "	4.9	0.7	1.6	0.9
6	Hunterlab D40 Reflectometer	3.0	4.4	3.1	4.9
13a	" " "	3.1	4.3	2.6	4.0
13b	" " "	3.0	0.8	4.1	5.1
9	Colormaster Diff Colorimeter	7.1	5.2	2.9	4.8
8	Color Eye	2.2	2.6	1.6	1.7
10	Gardner Color-Diff Meter	4.1	4.6	3.4	3.4
4	" " "	2.9	4.0	3.3	3.2
5	" " "	4.9	5.4	3.3	3.6
1	Hunterlab " "	4.0	3.7	3.4	3.7
12	" " "	0.6	1.1	2.4	2.3

glass is assumed to 10%, then roughly:

$$R_c = k \times R^{1.10}$$

Where R_c is measured reflectance with cover glass, R is measured reflectance without, and k is adjusted to make the standard give its correct reflectance reading. In Figure 8 are plotted the green reflectance values for the four specimens, R being plotted as abcissa and R_c as ordinates. On this same graph is shown the curve $R_c = k \times R^{1.10}$ with standard adjusted to unity at 86. It will be seen that most of the experimental points lie close to this computed curve.

However, the value for the cotton pile fabric lies well above the curve in Figure 8. When compressed against glass, the cotton pile carpet is more opaque and thus reads higher in reflectance than when its pile stands free so that light can be trapped behind and between the pile tufts. The measured increases in reflectance due to compression against glass are pronounced when the specimens are pile fabrics or are normally low in density so that light may penetrate when they are not compressed. With flat opaque fabrics, the effects of compression are much less.

To summarize, the use of cover glasses results in:

1) Marked improvement in precision,
2) Nonlinear readings of reflectance,
3) Higher reflectances because of compression, chiefly with pile fabrics and specimens of low density.

OTHER EFFECTS———Wherever the sigmas in Table IV are above two, the original reflectance data were studied to see what might have caused the large disparities.

The high value for B of the dark gray test panel was due to a 10% error in one instrument. This error was suspected to be due to grid leakage in a galvanometer tube. This is typical of the type of instrument defect the standard panels are designed to uncover.

The high standard deviations with the foam panel for both filters show that there are significant differences between the instruments in susceptibility to light losses from translucent specimens. If the fibers and nonwoven specimens studied during this test had not been so tightly compressed, disparities which correlated with those for the foam panel would probably have appeared.

Turning now to the textile specimens, the standard deviation is high on both B values for the wool fabric. The large disparities with this fabric were found to be due to the presence of unsuspected fluorescent brightener. Although this fabric has a definite yellowish cast, it, nevertheless, had brighteners enough to cause a blue reflectance change of 4% with a reflectometer capable of brightener evaluation.

The high standard deviations for the unmounted carpet specimen are probably due to the variability of pile-lay and orientation. When the cover glass was used to compress the pile in a uniform and random manner, the disparities between instruments dropped to less than half their original values.

The high standard deviation for B of cotton No. 8 is unexplained. The high B value for the nonwoven was due to one instrument. A repeat measurement of the specimen on this instrument decreased the disparity only slightly so that this discrepancy is also unexplained. It will be noted that the sigmas for B are generally greated than those for G.

The high standard deviations for the blue reflectances of the fluorescent specimens is, of course, explained by the above described differences in blue filter centroids and to the probable differences in illuminant color temperature.

OPERATOR CONTRIBUTIONS TO DISPARITIES———There are standard deviations of the order of 1.0 to 2.0 which remain after the larger sources of disparity are explained. It is of interest to know what part of this disparity can be ascribed to the limitations of the experiment, what part to the operator and what part may be due to the considerable differences between instruments used.

At one laboratory, one operator measured two sets of specimens on the same instrument. The standard deviation for the differences between the two instruments on all the textile specimens was .95. It was suspected that the operator had been careless about following instructions to rotate the specimens 90° between readings and accordingly she was told to again take two complete sets of data on one instrument, this time with only one set of specimens. This was done, but the standard deviation dropped only to .85. By contrast, two operators using one instrument and one set of specimens in another laboratory obtained differences giving a sigma of 1.3. One set of specimens measured by one operator on three markedly different instruments at a third laboratory produced a sigma of 1.4.

Although it would admittedly be desirable to repeat the present experiments with more careful statistical controls and analyses, it is quite

apparent from the foregoing that differences of the order of 1% in reflectance can be expected to occur when specimens of the present variety are measured even by one careful operator. Adding to the number of operators or to the variety of instruments will increase this disparity somewhat, but not seriously. One must look to the basic test method for sources of differences which average about 1%.

SPECIMEN ORIENTATION——— Examination of the data suggested that several of the operators sometimes failed to follow instructions and rotate each specimen 90° between readings. The effect of this 90° rotation was much larger on some specimens than on others. Table V shows the changes in measured reflectance with 90° rotation obtained by one operator who, it was apparent, was quite careful in her manipulation of the instrument. It will be seen that both the cotton knit and 80 square samples changed measured reflectance importantly when they were turned 90°.

Table VI shows differences between measured reflectance on all instruments with the regularly bleached 80 square cotton taken to avoid the fluorescence complication. There are significant departures from the 4.0% average change with rotation. These occur with instruments 2A, 2B, 13B, and 12. Data for instrument No. 11 failed to show the expected rotational changes. However, inquiry revealed that the pairs of readings reported for No. 11 were actually averages of pairs after the desired 90° rotation. For this reason, data for No. 11 are not included in Table VI. It should be noted here that the rotational change for instrument No. 8, which uses diffuse sphere illumination is still about half that for the 45°0° instruments. This instrument uses a 40° viewing angle. Only with diffuse illumination and 0° viewing would this rotational effect disappear.

It is fairly apparent that the operators of instruments 2A, 2B, 13B and 12 sometimes forgot to rotate their specimens. However when their data are removed and standard deviations are recomputed, the decreases of sigma are negligible. In spite of this, differences in specimen orientation are believed to be a major factor in the disparities which remain. Specimen orientations were only made by eye and this method or orientation is not exact enough for highly precise work.

YELLOWNESS———As was noted above, the eye is roughly four times as critical of yellowness (measured by G—B) as of reflectance (G) alone. Thus, relatively poor precision in measurement of reflectance is tolerable if the precision for G—B differences is high. (One of the advantages of the Color Difference Meter is its direct response to G—B signals. It thus avoids the errors introduced by separate reflectance readings).

Values of yellowness were computed from readings of the three specimens behind cover glass to determine whether the instrument precision for yellowness was better than that for reflectance. This yellowness precision should be better because changes in reflectance from wrinkles, orientation, compression, etc should be eliminated if the specimens are not moved between readings. Standard deviations between instruments for green, for blue, and for yellowness of these three specimens are as follows:

	Standard Deviations		
	G	*B*	*Yel*
Greige	.6	1.1	1.3
Bleached	1.5	1.3	.6
Carpet	1.3	1.4	.7

Fortunately, the standard deviations for yellowness are definitely better than those for reflectance except in the one case of the greige specimen. In this case, the above mentioned grid current B error is responsible for the high sigma value of both B and Yel.

CONCLUSIONS

It is apparent from the data reported above and from the experiences gained during the present study that careful work is essential both in instrument calibration and operation if repeatable measurements of reflectance, yellowness, and whiteness of textile materials are to be obtained. If proper precautions are taken, it is believed that one may expect agreement to 1.0 units or less for different instruments, different operators, and flat nonfluorescent specimens.

Instruments do not have to be of the same make and model for this comparison of results, but standards must have the same basis of calibration and there must be uniformity in the techniques of specimen presentation. A series of standard panels is being developed to reveal important differences between instruments. Use of such series should eliminate most of the disparities arising from instrument characteristics. This series should be useful both for keeping instruments in calibration and for intercomparing different instruments.

For reproducible measurements of textiles, however, the technique of presenting the specimen for measurement is generally the most important aspect of the problem of obtaining accuracy. To obtain reflectance, yellowness, or whiteness measurements of textile specimens, which will be repeatable from time to time and from one laboratory to another, the following recommendations are made:

1) Use standards similar to specimen in reflectance and read at the end as well as at the beginning of each series of observations in order to identify and adjust values to compensate for any instrument drift.

2) Use a cover glass where possible and expose several thicknesses of the specimen backing it with the standard and with a uniform force to provide repeatable compression.

3) Orient specimens carefully before observation, once in the warp and once in the fill direction so as to provide a color value typical of the specimen. Note that direction of orientation is critical for many textile specimens.

4) Where fluorescent brighteners are present, note whether the ultraviolet absorbing filter is before or after the specimen in the light path. Use blue centroid test on blue source-filter-photodetector combination.

5) With fibers, pile fabrics or other bulky specimens, randomize fiber orientation and compress specimen against cover glass with standard force.

In closing, it might be noted that because instrument and textile technologists worked together on this project, problems were recognized and studied which either group working alone might not have uncovered.

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A Study of the Drying of Cotton Fabric and its Effect on Subsequent Dyeing and Finishing———

(*concluded from page 44*)

end result, have been neglected. This is a subject worthy of further study by our industry.

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AATCC Calendar

COUNCIL; NATIONAL COMMITTEES
Oct 26-27 (Sheraton Hotel, Philadelphia, Pa); TCR, research and administrative committees
Nov 17 (Hotel Sherman, Chicago, Ill); Council and Annual Meeting (2 PM)
Jan 26 (Hotel Commodore, New York, NY); Council (10 AM)
Apr 12-13 (Francis Marion Hotel, Charleston, SC); Council, administrative and research committees

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Nov 14-17, 1962 (Atlanta Biltmore Hotel, Atlanta, Ga); Oct 30-Nov 2, 1963 (Boston, Mass); Oct 1-3, 1964 (Hotel Statler, New York, NY); Oct 14-16, 1965 (Conrad Hilton Hotel, Chicago, Ill); 1966 (Philadelphia, Pa)

DELAWARE VALLEY SECTION
Oct 27, Dec 1 (Beck's Restaurant, Philadelphia, Pa)

HUDSON-MOHAWK SECTION
Nov 17 (Albany—Nopco, Fiber Lubricants); Jan 12(Amsterdam—Monforts Reactor and the Jet Dyeing Machine); Mar 9 (Amsterdam—Water Repellents, 3M); May 25 (Albany—Historical Aspects of Dyeing); June 22 (Amsterdam—Annual Outing)

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Oct 20 (Kohler's Swiss Chalet, Rochelle Park, NJ—"Celluloslc Reactants", panel); Nov 17 (Suburban Golf Club, Union, NJ—Plant visit to Shell Chemical Co Laboratories); Jan 19 (New York, NY—"Costs", D M Lewis, Colonial Piece Dye Works); Feb 16 (New York, NY); April 13 (Ladies Night—Margaret Ingersol, *Vogue*); May 18 (Kohler's Swiss Chalet, Rochelle Park, NJ—"Nonwovens—Dyeing and Finishing", panel); June (Outing)

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Nov 18 (Chicago, Ill)

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Oct 20 (Quartermaster R & E Command, Natick, Mass); Dec 18 (Motel 128, Dedham, Mass); Jan 19 (Woodlawn Country Club, Newton, Mass)

PACIFIC NORTHWEST SECTION
Nov 10 (business meeting)

PACIFIC SOUTHWEST SECTION
Nov 17

PALMETTO SECTION
Jan 20-21 (Poinsett Hotel, Greenville, SC); April 14-15, 1962 (Francis Marion Hotel, Charleston, SC)

PIEDMONT SECTION
Jan 27 (Hotel Charlotte, Charlotte, NC); Apr 7 (Hotel Barringer, Charlotte, NC); June 8-9 (1962 Outing—Mayview Manor, Blowing Rock, NC); Sept 29, 1962 (Hotel Barringer, Charlotte, NC)

RHODE ISLAND SECTION
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Lowell Technological Institute

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Anil S Merchant—Student, Lowell Tech Inst, Lowell, Mass. Sponsors: G R Griffin.

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Alan D Grover—Overseer of dyeing, Excelsior Finishing Plant, Pendleton, SC. Sponsors: W V Walukewicz, D W Gardner.

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Necat R Tezcan—Graduate student in textile chemistry, Lowell Tech Inst, Lowell, Mass. Sponsor: G R Griffin.

New Bedford Institute of Technology

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John D McKay — Student, New Bedford Inst of Technology, New Bedford, Mass. Sponsors: F Tripp.

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It is presumed that authors in studying the comments of reviewers and of the Editor will remember that all recommendations are made in a kindly, helpful, sympathetic manner to improve the paper in both literary and technical excellence. Although authors should cheerfully consider suggestions, they are expected to defend their position if justified, especially when strictly technical matters are involved with which the authors have an intimate knowledge.

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In the organization of the material, there should be one or more introductory paragraphs setting forth the occasion, significance and main objectives of the paper and of the method of attack. This should be followed by the body of the presentation, either with discussions interspersed throughout this portion or with a collected section marked "DISCUSSION" after the main body of the paper. Finally, there may be a brief section at the end entitled "SUMMARY" or "CONCLUSIONS."

Center and side headings make for easier reading. Center headings should be employed sparingly and generally will include only very important section headings, such as "INTRODUCTION," "EXPERIMENTAL," "DISCUSSION," "CONCLUSIONS," "SUMMARY," and "REFERENCES." Side headings (see sixth paragraph of this *Notice* for an example) shall be indented and run into the text to which they apply, and shall be separated from the paragraph by a dash. The publisher will print center headings in bold-face capitals and side headings in capitals.

LITERATURE REFERENCES AND FOOTNOTES—References to the literature and all footnotes (except those in tables) shall be numbered consecutively with underlined Arabic numerals in parentheses at the proper place in the text. Where a reference or footnote is to be used again, the original number is simply repeated; this obviates the necessity of repeating the footnote or reference at the bottom of the page. References to the literature shall conform to the universal usages followed by *Chemical Abstracts*, which include underlining of journal names to indicate italicization in printing. The abbreviated codes for many journal names appear on page 183 of the 1959 *Technical Manual*.

The spelling and rules of punctuation followed in manuscripts shall be those found in the "Merriam-Webster New International Dictionary"; abbreviations and chemical formulas shall conform to *Chemical Abstracts*.

FIGURE AND GRAPHS—Figures and graphs should be black line drawings on white drawing paper. Photographic prints are acceptable, preferably glossy prints on double-weight paper. Duplicates should be available for dispatch to reviewers. In graphs the frame and actual curves should be inked more heavily than the coordinate lines, and these latter should not be too close together. Various styles of broken lines are sometimes desirable to distinguish curves. Experimental points should be given with small plane figures, such as circles, squares, diamonds, or triangles. Numbers and legends on co-ordinate axes are to be lettered in the graph by the author. Number and titles of figures should be placed below the diagram or on the edge of the back. Each piece of illustration copy should bear on the margin or on the edge of the back the name of the author and the title of the paper.

SYNOPSIS—A separately written synopsis of not over 200 words containing the gist of the subject matter must accompany every manuscript.

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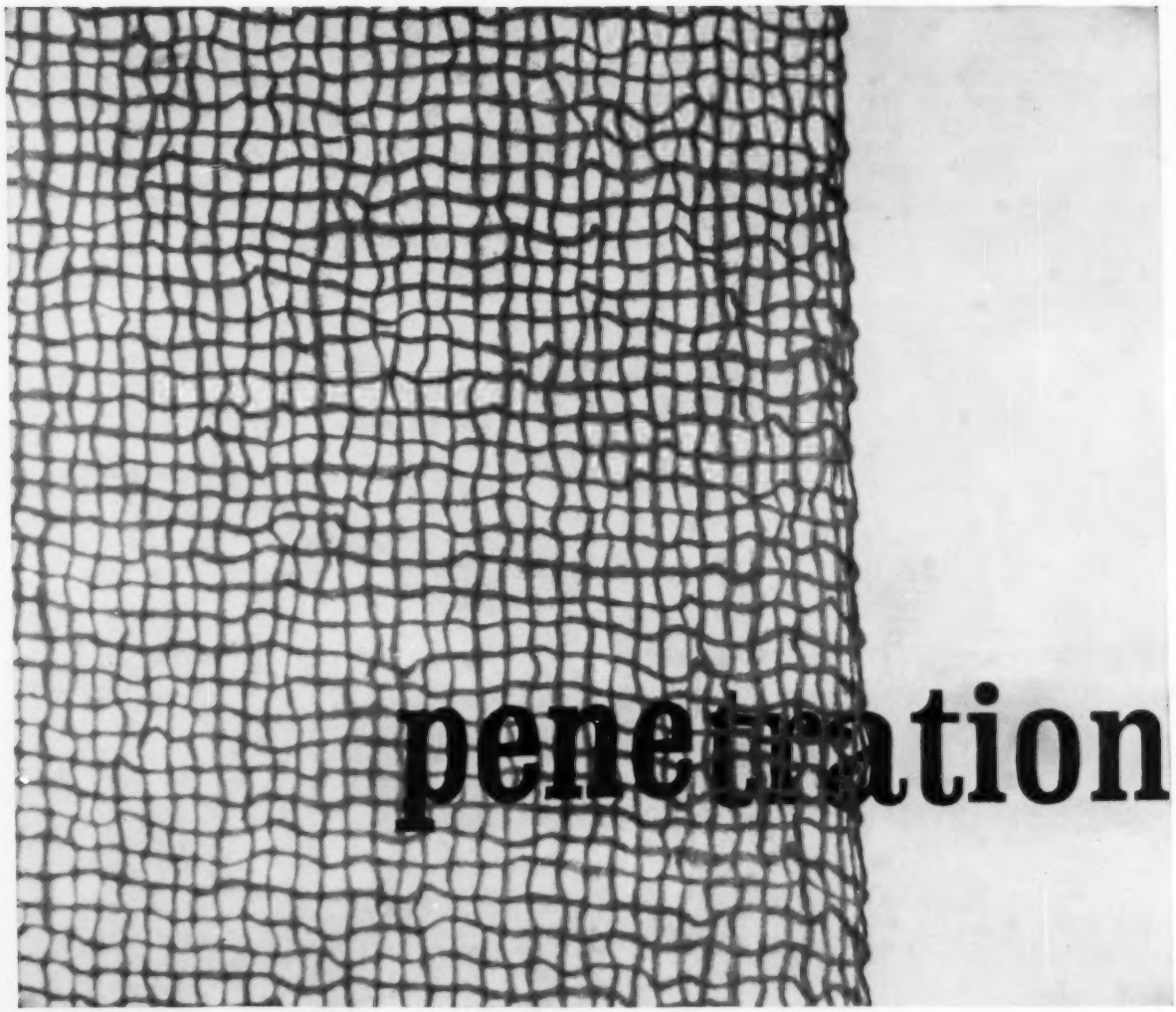

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ORGANICS DIVISION Olin

BOOK REVIEWS

Diazo and Azo Chemistry: Aliphatic and Aromatic Compounds

Author: Heinrich Zollinger
Published by: Interscience Publishers, Inc (April 1961)
250 Fifth Ave
New York 1, NY
pp: 444
Price: $16.50

This noteworthy volume by Professor Heinrich Zollinger is now available for the first time in the English language and it is indeed an outstanding work; a "must" for every worker in the field of dyestuffs. The arrangement of chapters, and thorough scholarship of the work is a model to be aspired towards for scientific authors. An impressive reference list of 2,388 entries as well as a list of 210 patents, an index of 37 pages and a list of code letters for dye manufacturers make this well-illustrated volume a valuable addition to the working library of the investigator and dyestuff manufacturer.

•

The Proceedings of the National Conference on Water Pollution held in Washington, DC, December 12-14, 1960

Published by: US Dept of Health, Education, and Welfare
Public Health Service
Washington 25, DC

A reasonable number of copies of this report may be obtained from the office of:
Frank A Butrico
Executive Secretary
National Conference on Water Pollution
Room 4216 South Building

GENERAL CALENDAR OF COMING EVENTS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, TEXTILE ENGINEERING DIVISION
Nov 1-2 (Annual Meeting———Massachusetts Institute of Technology, Cambridge, Mass); Apr 11-13 (Spring Meeting———North Carolina State College, Raleigh, NC)

FIBER SOCIETY
April 11-13 (North Carolina State College, Raleigh, NC)

INTERNATIONAL TEXTILE MACHINERY EXPOSITION
Sept 1962 (3rd Exposition, Hannover, Germany)

NARROW FABRICS INSTITUTE, INC
Nov 13-15 (Statler-Hilton, New York, NY)

NATIONAL COTTON COUNCIL OF AMERICA
Nov 8-9 (1961 Chemical Finishing Conference———Sheraton Park Hotel, Washington, DC); Oct 3-4, 1962 (1962 Chemical Finishing Conference———Sheraton Park Hotel, Washington, DC)

NATIONAL RETAIL MERCHANTS ASSOCIATION
May 20-23 (Fibers, Fabrics and Finishes Exposition———New York Trade Show Bldg, New York, NY)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
Nov 14 (Luncheon Meeting———Palm Terrace Suite, Hotel Roosevelt, New York, NY); Dec 7 (Annual Meeting and Dinner——— Hotel Roosevelt, New York, NY)

WORLD CONGRESS FOR MAN-MADE FIBERS
May 15-18, 1962 (2nd World Congress, London, England)

1962

AMERICAN DYESTUFF REPORTER

PUBLICATION DATES

JANUARY	8-22
FEBRUARY	5-19
MARCH	5-19
APRIL	2-16-30
MAY	14-28
JUNE	11-25
JULY	9-23
AUGUST	6-20
SEPTEMBER	3-17
OCTOBER	1-15-29*
NOVEMBER	12-26
DECEMBER	10†-24

. . . AND SPECIAL ISSUES

*AATCC CONVENTION ISSUE
October 29, 1962
Advertising Closing Date October 8, 1962

†ANNUAL PROCESSING REVIEW NUMBER
Publication Date December 10, 1962
Advertising Closing Date November 19, 1962

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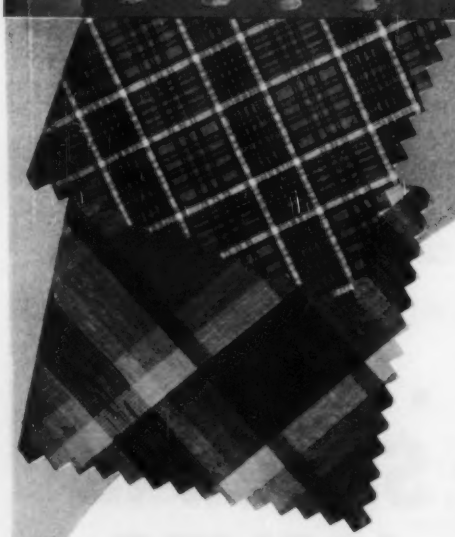

A BIG NAME IN APPAREL AND HOUSEHOLD FABRICS

A well known and highly respected fabric producer for many years, Dan River's growth and expansion since World War II can only be expressed by one word—PHENOMENAL.

We are proud that we have been privileged to participate in Dan River's many multi-million dollar modernization projects through the years.

Since 1940 we have installed 67 production kiers in the Danville plants and 9 kiers in one of the Alabama plants. Machinery arrangements permit dye lots to range from 100 pounds of beams or cheeses.

During the same period Dan River's Department has installed 12 small dyeing machines ranging from 1 pound to 40 pounds per machine.

40th ANNIVERSARY

Gaston County Dyeing Machine Co.

GASTON COUNTY

WORLD'S LARGEST PRODUCERS OF PRESSURE DYEING & DRYING MACHINERY

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ADR News Report:

General News of the Industry
Personalities in the News
New Products, Developments, Processes

Reeves Grants License to Fab-Lace

Announcement has been made by Reeves Brothers, Inc, manufacturers of Curon foam, granting Fab-Lace, Inc, a license to laminate its own goods using Reeves' patented heat-laminating process, with the work to be done by Fab-Lace's subsidiary, Lamatronics Industries, Inc, Amsterdam, NY. Fab-Lace is also licensed to use the trade mark Curonized when the lamination has been made with Curon foam.

According to Arthur Kreizel of Fab-Lace, the firm, which presently manufactures rashcel and tricot fabrics, will specialize in warp knitted laminates. It offers a complete line of Antron and nylon, brushed and sueded cloths in addition to a group of novelties. All Fab-Lace's output will be offered with the new Curon E-Z finish designed for slip-ease sewability. Fab-Lace will market its lines through its New York sales offices at 20 West 37th St.

•

Oronite Phthalic Anhydride Contract Awarded

The contract for the design, engineering and construction of a 30-million-pounds-per-year phthalic anhydride plant has been awarded to Badger Manufacturing Co by California Oil Co, Eastern Division. The plant will be constructed at Perth Amboy, NJ, and is expected to be completed in the fall of 1962.

California Oil Co will operate the plant for Oronite Division of California Chemical Co.

Design for the plant will be based on California Research Corp's fixed-bed process for phthalic production by oxidation of orthoxylene. The process is said to be an improved version of that used in an Oronite plant built in 1945, which reportedly was the first commercially successful orthoxylene-phthalic unit.

This project is the eleventh phthalic anhydride contract awarded to Badger since mid-1958 and is said to make the total annual capacity of these Badger plants well over 300 million pounds.

•

Biddle Sawyer Forms New Enzyme Division

Biddle Sawyer Corp, chemical importers and distributors, has announced the formation of a new division, to be known as Enzyme Development Corp, which has been established for the purpose of expanding research, manufacturing and marketing facilities for enzymes and enzyme preparations, and to seek and promote new applications for enzymes.

Enzyme Development Corp is the outgrowth of a department of Biddle Sawyer, established several years ago, to conduct research, produce and distribute plant enzymes. Biddle Sawyer has operated joint research facilities with Nagase & Co, Ltd, an enzyme manufacturer in Japan. In addition, experimental projects in enzymology are currently being conducted with several universities in Japan and the United States.

Increasing knowledge, the corporation affirms, has emphasized the desirability of an expanded program, devoting even more attention to the preparation, purification and utilization of these biochemical catalysts. According to corporation spokesman, Enzyme Development Corp will be prepared to offer assistance to consumers in the form of analyses, studies, suggestions for improving present usage of enzymes, and potential new applications of enzymes in the other industries. For research workers, a number of highly purified and newly isolated crystalline enzymes will be available.

Headquarters for the new division are at 64 Wall St, New York 5, NY.

•

Ames Textile Corp Division Purchases Shawmut, Inc

I A Wyner & Co, division of Ames Textile Corp, has announced that it has purchased the knitting, dyeing and finishing business of Shawmut, Inc, located at Porter St, Stoughton, Mass.

The wholly owned facility will increase by upwards of 112,000 yards a week the finishing production of the Wyner division, according to Ames Stevens, Jr, treasurer.

Mr Stevens said the purchase is another vital step in the expansion of the Wyner Division in the knit goods business. One of the basic reasons for the purchase, he said, was to insure Wyner of the entire output of the Shawmut mill, where for many years it has been a major customer.

The Wyner Division, known for its Sag-No-Mor label, became a part of Ames Textile Corporation in 1960.

•

Metal Hydrides and Bayer, Germany Sign Agreement

A reciprocal agreement has been signed between Metal Hydrides Inc and Farbenfabriken Bayer Aktiengesellschaft, Leverkusen, West Germany, for cooperation in expanding markets for alkali metal borohydrides.

The purpose of the agreement is the exchange of information in respect to uses of borohydrides in various fields of industry. Subject to existing commitments, cooperation is established on patents and licensing. This also includes manufacturing know-how under certain provisions.

Metal Hyrides Inc produces alkali metal borohydrides in the United States; Bayer is the sole producer in Europe.

•

Covington Plant Completed by Hercules

Hercules Powder Co, commercial producer of polypropylene, has announced completion of its multimillion-pound polypropylene fiber plant in Covington, Va. This plant, with an initial annual capacity of 12 million pounds, is readily expandable in order to meet the market demands of the future, according to Forest B Evans, manager of the Fiber Development Department.

Hercules' polypropylene fiber is being produced at the former Industrial Rayon Corp nylon facility, which has been completely redesigned for this purpose. In addition, a complete fiber research center has been established at Covington, occupying a large portion of the former IRC rayon plant there. Facilities have been built to perform all steps in fiber development from chemical research through fabric construction and end-use testing.

Hercules polypropylene fiber is available in three forms: continuous multifilament yarn, staple fiber, and tow. Reportedly possessing properties of high strength, lightweight, and excellent coverage, Hercules' polypropylene fiber is said to offer the textile technician and designer new opportunities in a variety of markets. The fiber is suggested for use in woven, nonwoven, tufted, and knitted fabrics.

Sales headquarters for Hercules Fiber Development Department are at 380 Madison Ave, New York, with a recently opened branch office at 1214 Wachovia Bank Bldg, Charlotte, NC.

•

Chemical Process to Handle West Coast Distribution of Specialty Resin

Atlas Chemical Industries, Inc, Wilmington, Del, has announced that distribution of Atlac 382 bisphenol polyester resin on the West Coast will now be handled by Chemical Process Co, Redwood City, Cal, in a ten-state western area.

Atlac 382 is a specialty resin used primarily in the construction of corrosion-resistant chemical process equipment. The resin will be available through Chemical Process both as a dry powder and in various blends with styrene.

At the present time Chemical Process manufacturers Dion ortho and isophthalic polyesters and maintains sales and technical service in its marketing area. The Atlac resin will be sold by the same sales organization currently handling the Dion and Dion-Iso line.

NEW PRODUCTS AND DEVELOPMENTS

Lotol L-4634-D

A new, self-curing latex compound for carpet backing, which is said to require approximately half the amount of thickener material used in standard compounds, has been developed by the Naugatuck Chemical Division, United States Rubber Co.

In addition to allowing economical use of expensive thickening materials, the new compound has good heat and light-aging characteristics, it is claimed. It also is said to have excellent low-temperature properties and high filler tolerance.

Lotol L-4634-D, the new material, is the second self-curing latex compound developed by Naugatuck Chemical. Principal advantage of the self-curing materials is said to be that they eliminate the need for high-temperature oven curing, which is expensive and time-consuming.

The self-curing compounds reportedly do not contain the usual sulfur curing agents and accelerator chemicals, which can cause offensive odors and staining.

It is stated that the new compound was specifically developed to enable carpet manufacturers to achieve additional economies during the backing operation. By requiring less thickening agents, and having a greater tolerance to filler materials, the new compound reportedly permits measurable savings.

These carpet-maker benefits have been realized without reducing other properties of the self-curing compound, it is claimed. Extensive tests reportedly show it has excellent tuft and pile lock, resilience, hand and resistance to deformation. Fade-Ometer tests are said to demonstrate that it is more resistant to heat and light-aging than other self-curing compounds now on the market.

The new compound is currently being produced, and is being used by several carpet makers.

•

Floating Foam Arrestor for Portable and Stationary Mixers

A floating foam arrestor is now available for use on Barrington Industries' high-speed, high-shear mixers, for those instances in which foam is created as a result of especially troublesome materials.

The floating mats are custom cut to customer specifications so as to almost completely cover the surface of the material in the mixing tank. They are attached to the shaft of the Barrington mixer and adjusted to lay on the surface of the liquid mix. Material forced to the surface during mixing is deflected horizontally along the bottom of the mat and down the sides of the mixing tank.

Barrington's floating foam arrestor concept is covered by a pending patent application. It is available on a full range of mixers with capacities from 3 gallons to stationary units with capacities in excess of 3000 gallons.

For addtional information contact: Barrington Industries, Inc, 185 Union Ave, Providence 9, RI.

•

Floktex

A new silk-screen flocking adhesive which reportedly will not clog screens and is said to eliminate costly down-time has been developed by Adhesive Products Corp, 1660 Boone Ave, New York 60, NY. Designated Floktex, the adhesive is reportedly excellent for adhering glitter, beads, flock and decorative materials to fabric and other surfaces.

Floktex, said to be easy to apply and capable of remaining permanently flexible, reportedly will not discolor materials. According to the Company, the adhesive can also be applied by printing press, making high-speed flocking operations possible.

Floktex is the newest addition to the Company's line of flocking and silk-screen adhesives, which also includes adhesives for flocking on such surfaces as Mylar, polyethylene and polyurethane foam.

Floktex is packaged in 55-gallon drums, and in one- and five-gallon containers.

Harflex 340

The Harchem Division of Wallace & Tiernan Inc is introducing a polar polymeric plasticizer for use with polyvinyl acetate.

Called Harflex 340, it is said to impart wet tack, specific adhesion and permanency not previously attainable, to polyvinyl acetate adhesives.

Harflex 340 reportedly has been approved by the Food and Drug Administration for food usage.

According to Harchem officials, this performing plasticizer is available at an extremely reasonable cost.

Other suggested applications for Harflex 340 include carpet-backing compounds, binders for nonwoven fabrics, laminating adhesives and barrier coatings.

Data and samples are available through the Product Development Dept, Harchem Division, Wallace & Tiernan Inc, 25 Main St, Belleville, NJ.

•

SBC-2047-1

The Angler Adhesives Department of Interchemical Corp Finishes Division, 120 Potter St, Cambridge, Mass, has announced a primer reportedly providing excellent adhesion of plastisol coatings to nylon fabrics. Known as SBC-2047-1, the adhesive is supplied in two parts, which are mixed in the ratio of four ounces of Part B to one gallon of Part A. After mixing, the adhesive is said to have a pot life up to 48 hours. It may be applied by knife-coating or dipping at a dry film weight of 0.8 to 1.0 ounce per square yard, initially set for one minute at 250°F, then cured for 45 seconds at 350°F. The short-term heating at elevated temperatures reportedly minimizes shrinkage of the nylon. The plastisol coating may then be applied at thicknesses ranging from 1 to 20 mils and fused at approximately 360°F.

Bond strengths as high as sixty pounds per two-inch width reportedly have been obtained when tested in accordance with ASTM Method D751-59T.

The primer is said to provide excellent flexibility, resistance to water and high humidity, stability to plasticizer migration, retention of fabric tear strength and absence of staining in light colored plastisols.

•

Emkasans

Emkay Chemical Co, Elizabeth, NJ, is introducing a new series of products which will be called Emkasans. The first of this series, Emkasan QA-50 is now in production and available in trial or practical quantities.

Emkasan QA-50 is a cationic surface-active quaternary ammonium compound based on dodecylbenzyl trimethyl ammonium chloride. Its germicidal, algaecidal and disinfectant properties are said to be effective against most types of bacteria, fungi, algae, etc. It is being recommended by Emkay for many textile purposes and for many industrial uses.

Technical data sheets and further details as well as samples are available upon request from Emkay Chemical Co.

•

Glyoxal Special

Union Carbide Chemicals Company, 270 Park Ave, New York, 17, NY, has developed a new process for producing a glyoxal said to be of higher purity, with low color, and without traces of either ethylene glycol or formaldehyde. To distinguish the new product from other grades, it is identified as Glyoxal Special.

Glyoxal Special's reactivity reportedly has been increased by the elimination of impurities. The product's two-carbon dialdehyde structure has been cited by the Company as making Glyoxal Special applicable as an intermediate for textile and epoxy resins and in other areas where new chemical structures are continually being synthesized. The product's low color was also cited by the Company as extending Glyoxal Special's use as an intermediate for tetramethylol acetylene diureine and other creaseproofing agents for textiles.

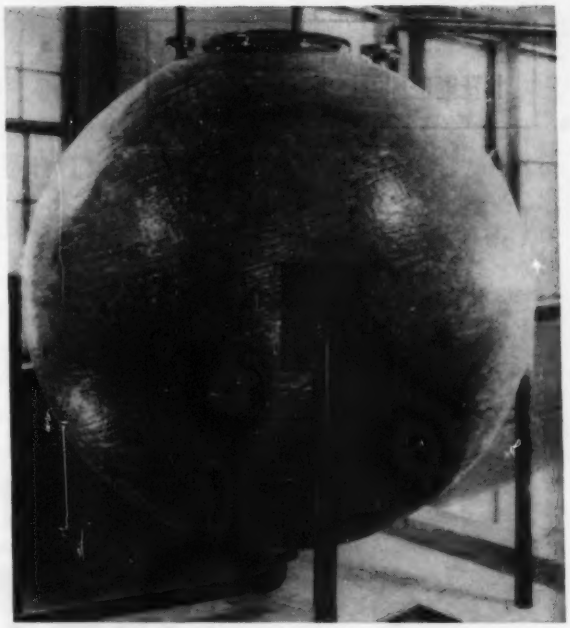
Chemisphere

The development of a spherical tank fabricated from a specialty glass-reinforced polyester and said to be light weight and low in cost has been announced by Justin Enterprises, Inc, 3755 Edwards Road, Cincinnati 9, Ohio. The tank, called the Chemisphere, is recommended by the company as a processing or storage unit for the textile and other industries, where corrosive conditions necessitate a structure with high chemical resistance. Weight of the Chemisphere is said to be approximately one-seventh that of a comparable stainless-steel unit.

The tank is fabricated through a process of winding continuous fibers impregnated with polyester resin on a spherical surface. The spherical shape reportedly possesses the advantage of 1) providing a minimum surface area per unit of volume and minimum stress concentrations, with resulting high strength-to-weight ratio, and 2) the bringing about of easy cleaning and complete drainage. The tank is currently available in diameters of 6 ft (847 gal) and 8 ft (2009 gal).

High resistance to corrosion reportedly is provided by utilizing a specialty bisphenol A polyester resin in conjunction with the filament-wound glass fiber. According to recently conducted tests, the results of which are available upon request, the bisphenol A polyester is more resistant to prolonged contact with most acids, alkalis, and bleaches at elevated temperatures than general-purpose or other polyesters. Chemical resistance of the specialty resin, called Atlac 382, a product of Atlas Chemical Industries, Inc, Wilmington, Del, reportedly is provided by its patented chemical composition based on bisphenol A.

Two separate processes are involved in the manufacture of the Chemisphere: 1) application of the "barrier" coat of bisphenol A polyester resin, to protect the main body of the tank from chemical attack at elevated temperatures, and 2) the buildiup of the main body of the tank by spherical filament winding.



Cost of the 6-ft Chemisphere with manhole, line connections, couplings, and drain connection, is priced at $585. The 8-ft model with the same manhole and fittings is priced at $900.

PERSONALITIES IN THE NEWS

Stoll

Williams

Fortess

Ostermayer

Berseth

The promotion of three executives to further strengthen its marketing programs hs been announced by Celanese Fibers Company.

Reiner G Stoll has been promoted to the new post of assistant director of marketing—plans and programs. He will be responsible for developing product marketing plans for both current and future Celanese fibers. Dr Stoll will have his headquarters office in New York and also will maintain an office in Charlotte, NC.

Robert D Williams succeeds Dr Stoll as director of the Celanese Fibers Applications and Product Development Laboratories in Charlotte. Dr Williams had been manager of product development at the laboratories since 1959.

Fred Fortess has been appointed assistant director of the laboratories. He had been manager of dyeing and finishing at Charlotte since 1956.

•

John A Harley, former assistant sales manager of Alliance Chemical Corporation and located at the Providence, RI branch of the company, has been named sales manager and will make his headquarters in the new office, laboratory and warehouse in Charlotte, NC.

H William Rose Jr, who was formerly in the application and control laboratory at the company's plant in Newark, has been named technical sales representative for New England.

Jack Roddy, who joined Alliance's sales force a few months ago, will work out of the Charlotte office, covering South Carolina, Georgia and Tennessee.

Pennsylvania Industrial Chemical Corp has announced the appointment of *R W Ostermayer Jr* as executive vice president. Mr Ostermayer has been in charge of plant management and production for his company for the past fourteen years.

Prior to joining the Pennsylvania firm, Mr Ostermayer was a research chemical engineer for the Celanese Corporation of America at Cumberland, Maryland, and Bishop, Texas, where he helped to develop a new plant and process for the oxidation of light petroleum constituents.

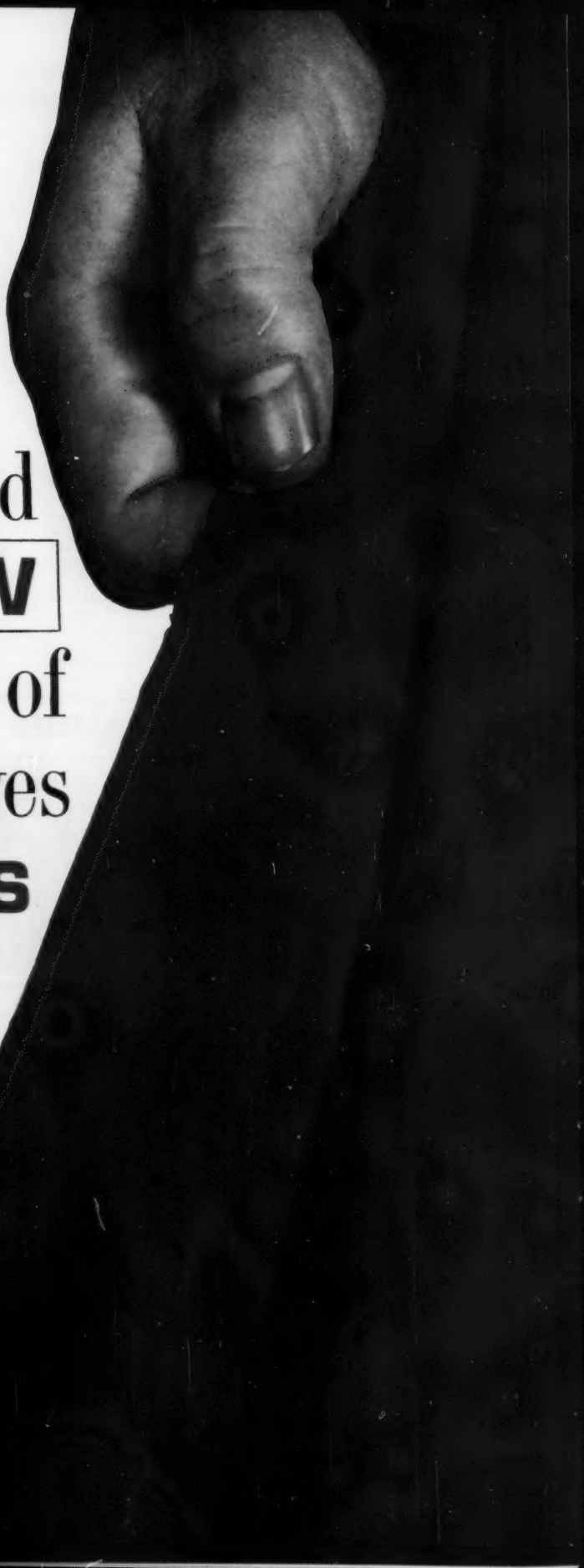
Also appointed to a new position in the Company was *Albert M Berseth*, named new head of process, development, and maintenance to replace *Ronald Neubert*, who has been promoted to general production manager of this company. Mr Berseth has been with Picco for eight years, and has advanced to this position from process engineer. Mr Berseth was formerly operation foreman for the Pure Oil Company in Smith's Bluff, Texas, and has served, in addition, as development engineer with the Sun Oil Company in Marcus Hook, Pennsylvania.

•

Dean E McCrory has been appointed assistant district sales manager at Tacoma, Washington for Pennsalt Chemicals Corporation, replacing *Ralph C Schaeffer*, who was earlier named district sales manager at Salt Lake City.

McCrory joined Pennsalt in 1936 and subsequently served in chemical sales capacities in Pittsburgh, Philadelphia, Washington, DC, Los Angeles and Portland, Oregon.

Another
INTERCHEMICAL DEVELOPMENT!



A brand NEW series of disperse dyes PRODUCES LIKE SHADES

- Side - To - Side
- Side - To - Center
- End - To - End

INTERCHEM HISPERSE DYES
Extra-Fine Particle Size Dyes For Pad-Jig Dyeing Synthetic Fabrics

SAVE TIME
SAVE MONEY
IMPROVE QUALITY

Many leading dyers have proved Hisperse Dyes "mill-worthy" on a production basis for pad dyeing acetate, triacetate, and polyamide fabrics.

Major advantages include:

ECONOMY—Fabrics can frequently be dyed in the greige, eliminating boil-off time. Dyeing time, steam costs, and use of auxiliary products are reduced. Also, reduced processing often improves hand.

UNIFORMITY—Minimizes shading from side-to-side, side-to-center, and from end-to-end of a run. There is no tailing off of shades. Seam bar marks are virtually eliminated.

EXCELLENT PENETRATION—Even on taffetas and other tightly woven fabrics; minimizes surface dyeing.

Because of their unique dispersion and excellent all-round dyeing properties, Interchem Hisperse Dyes have also been found advantageous for processing acetate, triacetate, and polyamide fabrics and blends by conventional dyeing in jigs and open Burlington Beam Units.

For full information on Interchem Hisperse Dyes, write or phone our office nearest you.

Interchem® Dyes

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Kooreman

William W Bussey, for several years associated with the textile chemicals industry, is now actively engaged in servicing textile plants in the Georgia area for Arnold, Hoffman & Co Inc. Prior to his appointment to the Ahco sales staff, Mr Bussey was with the Dyestuff and Chemical Division of General Aniline & Film Corporation.

●

Geo Alan Carruthers, formerly with Canadian Industries, Ltd, Millhaven, Ont, has joined Turbo Machine Co, Lansdale, Pa. He will work in the Research and Development Division at Turbo.

At Canadian Industries since 1954, Mr Carruthers was project engineer, responsible for mechanical design in the Textile Fibers Division.

●

Ralph E Taylor was recently appointed branch manager for the Chas S Tanner Co in Columbus, Ga, reporting to the Southern office in Greenville, SC.

In his capacity as branch manager, Mr Taylor will serve the area of Alabama, Arkansas, Georgia, Kentucky, Mississippi, Tennessee and Texas. His service will include special attention to bleaching, dyeing, and finishing in the textile industry.

Before joining Chas S Tanner Co, Mr Taylor spent seven years in plant production and six years in sales to textile plants.

●

P Park White, dyes and intermediates salesman for Du Pont in the Southern district, has been transferred to the staff of the Technical Laboratory at Deepwater Point, NJ, the company's Dyes and Chemicals Division has announced.

Mr White joined Du Pont in 1950 as a chemist at the Technical Laboratory and, since 1951, has been a technical demonstrator and salesman in the Southern district. In his new assignment at the Technical Laboratory, he will be concerned with technical and demonstration work in the area of paper dyes.

Named to succeed him is *Boyd F Vaughn*, who has had 15 year's experience with the company's Dyes and Chemicals Division as a salesman in the Chicago district. Mr Vaughn, who will make his headquarters in Mobile, will call on paper mills in Alabama, Arkansas, Florida, Louisiana, Mississippi, and eastern Texas.

●

Armour Industrial Chemical Company has announced the appointment of *Karl M Bierman* as marketing staff manager. Mr Bierman was formerly eastern regional sales manager for the company.

In his new position he will direct the industry managers, market research and market development groups in providing information and assistance to the various field and sales departments.

Also named to a new post in the Company was *R H Warner*, formerly located in Chicago, who has been named Western regional sales supervisor.

Mr Warner's headquarters will be at 1916 South Tubeway Ave, Los Angeles, Calif.

E L Rhoads, formerly western sales manager, has been named eastern regional sales manager. Mr Rhoads will be headquartered at the Armour office in Lodi, NJ.

●

North Carolina State College has announced the recipients of two of its 1961-62 scholarships.

Wayne Dale Bolick of Hickory, a senior in the textile technology curriculum, has been awarded the $400 Underwear Institute Scholarship.

A $500 American Viscose Corporation Scholarship has been awarded to *Marvin Burnell Braddy*, a senior in the School of Textiles.

To improve general operating efficiency, Penick & Ford, Inc, recently instituted the position of industry manager, with broad planning and coordinating responsibilities for activities in specific industries.

Promoted to industry manager—textiles is *J R Heard*. His most recent position with Penick & Ford was manager of the Textile Division of the Technical Sales Service and Field Development Department.

R I Bashford, whose most recent Penick & Ford assignment was manager of the Paper Division of the Technical Sales Service and Field Development Department, has been promoted to industry manager—paper.

J A Kooreman, most recently manager of the Food Division of the Technical Sales Service and Field Development Department, has been promoted to industry manager—food and allied trades.

●

Recipients of a number of scholarships have been announced by Clemson College School of Textiles as follows:

Thomas W Templeton, senior majoring in textile chemistry, has been awarded a special South Carolina Textile Manufacturers Association scholarship of $250.

The Seydel-Woolley Scholarship has been awarded *Spurgeon B Brian*. An award of $300, the grant is presented each year to a junior or senior male student majoring in textiles.

Two seniors majoring in textile chemistry, *Robert C Hartzog* and *Gerald S Rose*, are recipients of $250 Blackman-Uhler Scholarships.

The David Jennings Memorial Scholarship has been awarded to *William E Barrineau*, a sophomore with textile management major.

Messrs Templeton, Rose, and Hartzog are student members of AATCC.

●

Shell Chemical Company has announced a number of personnel promotions and transfers which implement recent changes in the marketing organization of the Plastics and Resins Division.

R M Maybee has been named manager of plastics technical service at the Union, NJ, technical service laboratory. He will be assisted by *V O DeCoster* as supervisor technical service-olefins and *P M Ciofalo* as supervisor technical service-polystyrene.

Two technologists in the resins product group of the head office sales development organization have joined the laboratory staff. *R E Brown* has been appointed technical service supervisor-resins and *F T Watson* a senior technologist.

Aligning the district sales staffs along the same product lines, the following men have been appointed supervisors of district sales-resins: *P H Teliha*, Central (Chicago) District; *R M Seppala*, East Central (Cleveland) District; and *F W Breslin*, Eastern (New York) District.

At the same time *R S Davis*, a technical salesman in the Central District, has joined the head office sales development resins product group as a technologist.

●

James C Fanning and *Philip Marullo* have joined the Clemson College faculty this fall as assistant professors of chemistry.

For the past year Dr Fanning has been pursuing postdoctoral work at Tulane University. He replaces *William Sutton*, who resigned to continue work toward the doctorate degree.

For the past year Dr Marullo has been doing postdoctoral work as a research associate at the California Institute of Technology. He replaces *Stanley Kudzin*, who has accepted a teaching position in Pennsylvania.

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Appointments of *Richard B Sines* and *Joe Kaye* as sales representatives for the Lukenheimer Co, Cincinnati, O, manufacturer of valves, has been announced.

Mr Sines was named representative in West Virginia, southern Ohio, and eastern Kentucky; Mr Kaye will cover the Houston, Texas, area, southeast Texas and southwestern Louisiana.

●

Interchemical Corporation has announced the appointment of *Henry Kelleher* as an industrial relations representative for the Company.

Before joining Interchemical, Mr Kelleher served in personnel capacities with the Flintkote Co and the Universal Atlas Cement Co.

●

Emery Industries, Inc, Cincinnati, Ohio, has named *A C Fusaro* director of advertising. Mr Fusaro, who has been Emery's assistant director of advertising for the past four years, will be responsible for advertising and public relations for all of the Company's six operating divisions, in addition to corporate activities.

Advertising and literature for Emery's complete line of textile chemicals, organic acids, plasticizers, and jet-engine lubricant bases will be managed by *E L Spencer*. Mr Spencer has had five years' experience in Emery's advertising department.

E W McNerney, who has had 13 years experience in Emery's advertising department, will handle the advertising and merchandising programs connected with the Sanitone Drycleaning Process.

John Honeyman, center, distinguished British research chemist, recently visited the USDA's Southern Utilization Research and Development Division at New Orleans, La, to confer with staff members on chemical treatment of cotton. Dr Honeyman, head of Chemical Finishing Department, The Cotton Silk and Man-Made Fibers Research Association (Shirley Institute), Manchester, England, was especially interested in reviewing progress on research projects on chemical treatment of cotton currently being conducted at the Shirley Institute under PL 480 grants. While at the Southern Division, Dr Honeyman, author and lecturer, presented a seminar on "Textile Chemical Research at the Shirley Institute." Pictured with him are C H Fisher, left, Southern Division director, who is showing cotton fabric samples chemically treated at the Division for flame-retardancy, water-repellency, "wash-wear", and other properties, and G E Goheen, assistant director of the Division.

●

Calvin L Immel, sales representative for Archer-Daniels-Midland Co in the Philadelphia area, has been promoted to technical specialist in the company's specialty chemicals department in Minneapolis. His transfer became effective September 1.

TECHNICAL LITERATURE

(Literature is available from sources listed in italics)

ALIPHATIC ORGANIC CHEMICALS——*Armour Industrial Chemical Co, Public Relations Dept, Chicago 90, Ill*——This 12-page catalog lists some 150 different Armour products along with specifications and typical applications. It covers the company's fatty acids, amines, diamines, acetates, quaternary ammonium chlorides, nitriles, amides, ethoxylated chemicals, fuel-oil additives, anticaking and antidusting agents and acid-corrosion inhibitors.

A page is devoted to the chemical composition of Armour fatty acids as determined by gas chromatograph, which is said to provide closer control of specification processing.

●

COMMERCIAL LAUNDERING OF FIBERGLAS CURTAINS AND DRAPERIES——*Dept 10, Owens-Corning Fiberglas Corp, 717 Fifth Ave, New York 22, NY*——20-page manual, "How to Add New Profits to Your Business: Large Fiberglas Curtains and Draperies" was developed after intensive research at OCF's technical laboratories in Ashton, RI, and with the cooperation of cleaning and laundry experts from the National Institute of Drycleaning and the American Institute of Laundering.

This handbook, illustrated with black and white photographs, gives comprehensive instructions and recommendations for the cleaning of large fiberglas curtains and draperies found in commercial and institution installations throughout the country. It is intended to offer assistance to every field concerned with the future of Fiberglas fabrics. The manual will be mailed to all members of the NID and the AIL and to key people in the curtain and drapery industry.

CORROSION RESISTANCE OF POLYESTER AND EPOXY RESINS——*Atlas Chemical Industries, Inc, Wilmington 99, Del; in Canada, Atlas Powder Co, Canada, Ltd, Brantford, Ontario*——This report describes how three different polyester resins—bisphenol A, isophthalic, and general-purpose—and a room temperature and heat-cured epoxy withstood immersion for up to one year in various corrosive aqueous solutions at elevated temperatures. The information included is intended to be of interest to those in the textile, chemical, and other industrial fields, where these materials are used in fabricating chemical-resistant equipment. The 16-page bulletin includes curves showing strength retention of the various resins after immersion in a number of corrosive solutions for periods up to one year. In addition, tables are provided to indicate other specific effects of the corrosive media on the resins.

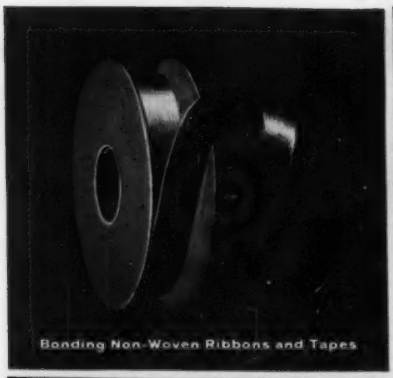
This information is provided to help the fabricators, designers, and users of equipment in corrosive service pinpoint the one material that provides the required corrosion resistance for a particular application.

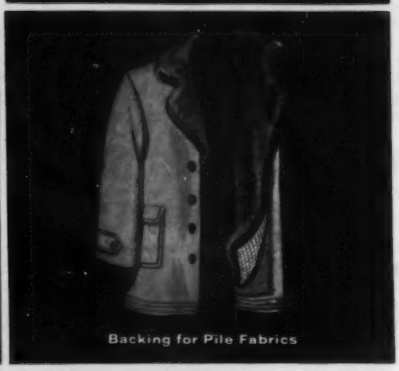
●

DATA ON SOLNUS "C"——*Industrial Products Dept, Sun Oil Co, 1608 Walnut St, Philadelphia 3, Pa*——A general-purpose lubricating oil, Solnus "C", recommended by Sun Oil Co for extremely wet conditions, has been incorporated in bulletin #17, the latest revision of the Company's technical bulletin on this line of oils.

Ten viscosity grades of low-cost Solnus oils are described in detail.

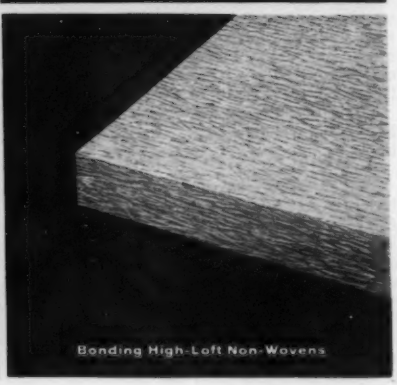
Bulletin also includes applications for the oils and benefits to its users.





NEW WAYS

the textile industry is using RHOPLEX acrylic resins to improve product quality



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ETHYLENE——*Technical Literature Dept, US Industrial Chemicals Co, 99 Park Ave, New York 16, NY*——20-page booklet, especially designed for developmental chemists and engineers using ethylene from cylinders, covers major chemical reactions of the ethylene molecule and gives extensive bibliographical references for further investigation of reactions involving ethylene's double bond. In addition, physical properties of ethylene are given in both tabular and graphic forms to provide maximum convenience for readers. A table of thermodynamic properties of liquid and saturated ethylene vapor is also included.

Ethylene is used in synthesis of six major derivatives: ethlyene oxide, ethyl alcohol, styrene, ethyl chloride, ethylene dichloride, and polyethlene.

●

LUNKENHEIMER KING-CLIP GATE VALVES——*Lunkenheimer Co, Cincinnati 14, Ohio*——Lunkenheimer King-clip gate valves, designed to withstand corrosive actions too severe for lighter valves, are described in newly-issued Circular 561.

Reports are given on the applications, features and designs of the King-clip, originated by Lunkenheimer. This valve is made in two types—the iron-body, bronze-mounted for general corrosive service; and the all-iron for solutions which attack bronze but not iron.

Steam pressure and water-oil-gas pressure ratings are listed, as well as specific dimensions for different King-clip designs. All are illustrated, including a cutaway for parts identification.

●

MOLYKOTE G——*The Alpha-Molykote Corp, 65 Harvard Ave, Stamford, Conn*——Typical applications of this grease-type lubricant said to contain a high concentration of molybdenum disulfide, and to be effective for extreme pressure applications, are featured in Bulletin 131. The ability of the material to prevent galling, seizing, fretting and metal pick-up is described.

Such actual applications as lubrication of heavy machine ways and guides, prevention of galling and seizing in threaded connections, reduction of cam wear, reduction of metal pick-up on lathe centers and steady rests, press fitting of bearings and gears on shafts, and prevention of fretting on splines are discussed and illustrated.

The four-color, two-page bulletin describes the lubricating characteristics of Molykote G and gives application instructions.

●

MSI DIGITAL DATA RECORDING AND ALARM SCANNING SYSTEM——*Monitor Systems, Inc, a subsidiary of Epsco, Inc, Dept 33, Fort Washington Industrial Park, Fort Washington, Pa*——Comprehensive 8-page, 4-color brochure describes Monitor Systems' Series 7000 line of modular Digital Data Systems for alarm scanning and digital recording of diverse types or combinations of analog values. Brochure discusses system design features, applications, and illustrates wide variety of standard building blocks and subassemblies available at MSI. Typical Series 7000 Data Systems for either low-speed or high-speed monitoring are illustrated. Data sysem flexibility, versatility, and expandability as well as the relation of design to overall system cost are discussed.

●

OZENE——*Solvay Process Division, Allied Chemical Corp, 61 Broadway, New York 6, NY*——20-page Booklet OC-1 tells how Ozene curbs objectionable odors and their causes—sulfide-forming bacteria and mold micro-organisms. Ozene, because of an emulsifying agent, reportedly is able to mix with water, thus utilizing the properties of orthodichlorobenzene, normally not water soluble.

A few parts per million of Ozene-water emulsion is said to have been successful in controlling odors from sewage-disposal plants, septic tanks, garbage cans, cesspools, drainage ditches, textile mills picnic areas and dairy and cheese plants.

The chemical is especially effective in removing grease, the booklet points out, because of its combination of high solvency and water rinsability.

●

RADIANT HEAT—TOOL OF INDUSTRY——*Fostoria Corp, Dept 109, 1200 N Main St, Fostoria, Ohio*——8-page, 2-color brochure explains the principle of radiant heat, describes Fostoria's equipment designed for utilization of the electric infrared radiant heating process, and pictures some of the many and varied industrial applications of its use.

Because infrared radiant heat is considered by Fostoria to be fast, efficient, completely controllable, safe and clean, it is regarded by the Company as a valuable tool in a wide variety of industrial uses. Although originally developed for paint baking on metal, Fostoria's equipment is presently used in the textile and other fields. In each case a substantial reduction of time and/or expense has resulted with the use of Fostoria's infrared processing equipment, according to the company.

●

SLACK SELVAGE ELIMINATORS FOR COATERS——*Mount Hope Machinery Co, Taunton, Mass*——Technical sheet describes Slack Selvage Eliminator Expanders designed to spread cloth widthwise and eliminate creases, wrinkles and "bagginess" prior to coating. The Slack Selvage Eliminator, using a spring tension roll, is said to take up slack in either selvage, holding material taut as it passes over one and under another expander roll while approaching the coating knife, reportedly assuring smooth, evenly coated material. Mount Hope engineers say the development is particularly important where materials are prone to coating cracks or soft selvages when stretched after drying or curing. The technical sheet also describes the use of free-wheeling expanders at delivery end of oven to remove wrinkles ahead of cooling drums and the use of batcher expanders to provide firm, wrinkle-free rolls.

The spreading effect of the Slack Selvage Eliminator Expanders is attained by one swinging roll followed by two expander rolls. In some cases, an additional fixed-bow expander is mounted just ahead of the coating knife to give a final smoothing effect to the fabric. This reportedly provides additional insurance against "chatters" or skips in the coating.

The units have been used for a number of years ahead of shearing machines, but the coating applications are said to have become equally important. Design innovations have been made to "custom-tailor" the Slack Selvage Eliminator to coaters.

●

SUMMARY NO. 4——*Manufacturing Chemists' Association, Inc, 1825 Connecticut Ave, NW, Washington 9, DC, $1*——This fourth edition of a statistical compilation of official figures on the chemical industry brings up to date through 1960 statistical information contained in the Association's Chemical Statistics Handbook which was published in 1960.

In addition to providing US government production statistics on a selected list of inorganic and organic chemicals, the supplement also contains final chemical data from the 1958 Census of Manufacturers released by the Bureau of the Census earliler this year.

The Statistical Summary points out that, according to US Labor Department figures, prices of chemicals and allied products in 1960 had increased only 10 percent since the base years of 1947-49, whereas prices of all commodities other than farm products and foods tripled.

On the other hand, chemical industry production workers' average weekly wages just since 1957 have risen from $91.46 to $103.91 in 1960, an increase of 13.6 percent, the Statistical Summary pointed out, citing Labor Department data. Average earnings of production workers in the government's category of "all manufacturing" rose from $82.39 in 1957 to $90.91 in 1960, or an increase of 10.3 percent.

The Statistical Summary also limits production data on specific chemicals for 1959 and 1960, by months, and provides a quick reference source for such information.

●

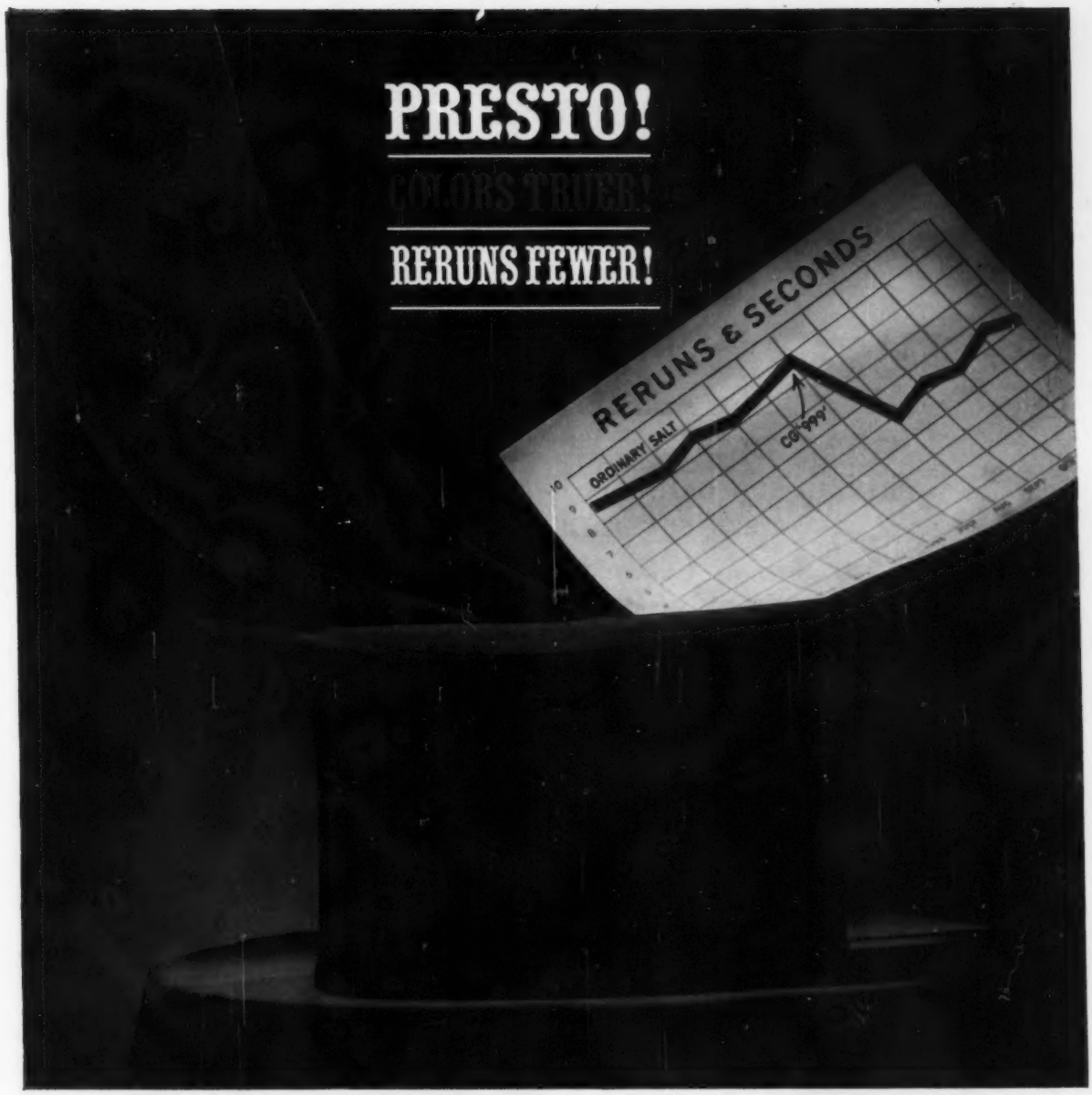
TETRAHYDROPHTHALIC ANHYDRIDE——*Dept NA 103, National Aniline Div, 40 Rector St, New York 6, NY*——21-page, revised technical bulletin on tetrahydrophthalic anhydride, gives physical and chemical properties, toxicity, handling precautions and uses.

Tetrahydrophthalic anhydride is used in the manufacture textile-treating agents, surface-active compounds and various other products.

●

ULTRAVIOLET, VISIBLE, AND NEAR-INFRARED SPECTROSCOPY——*Technical Information Dept, Beckman Scientific and Process Instruments Div, Fullerton, Cal*——Bulletin 795, a 36-page, pocket-size bibliography on ultraviolet, visible, and near-infrared spectroscopy, contains more than 250 references under headings of General, Technique, and Application.

Literature in the Technique section is listed under the following captions: Absorption, Flame, Fluorescence, Spectroradiometry, Reflectance and Colorimetry. The Application section includes references pertaining to spectrophotometry in various industries and areas of research.



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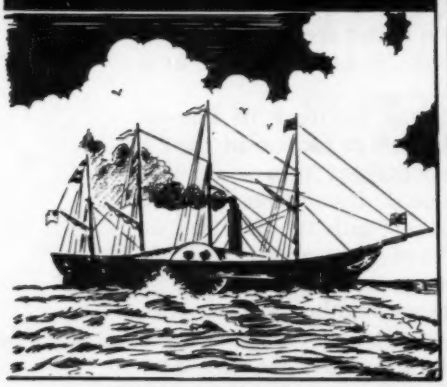

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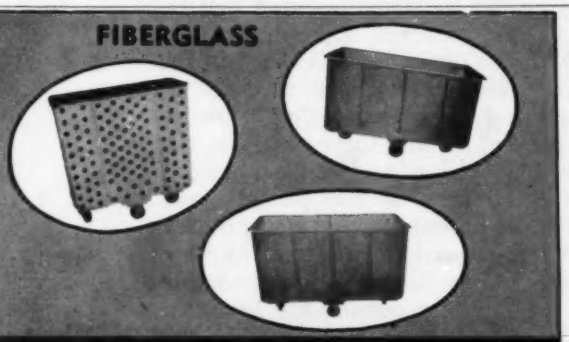

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COLOUR INDEX HUE INDICATION CHARTS AVAILABLE FROM NATIONAL HEADQUARTERS

Copies of the *Colour Index* Hue Indication Chart are now available from AATCC National Headquarters, P O Box 28, Lowell, Mass, at a price of $1.50 per copy.

The most important property of any coloring matter is its hue on a given substrate. The coloring matters in each usage section of Part I of the *Colour Index* have therefore been subdivided into a regular series of hue groups for which the conventional descriptions yellow, orange, red, violet, blue, green, brown and black (with the addition of white in the section devoted to pigments) have been adopted. This classification has been incorporated in the system of serial usage numbers in Part I. Each entry carries a reference number, eg, CI Acid Yellow 1 or CI Vat Blue 20; these numbers are consecutive within each hue group and will be extended as supplementary volumes appear. The commercial name under which a coloring matter is marketed does not necessarily give a precise indication of its hue. This is well illustrated by the wide divergence which frequently occurs in the commercial names used by different manufacturers for the same coloring matter. To overcome these inconsistencies and to introduce some measure of standardization a *Hue Indication Chart* was devised. This chart, in the shape of a hexagon, gives prominence to the six major divisions of alternate primary and secondary hues and at the same time provides continuity. Each side of the hexagon is divided into three parts, eg, the yellows are divided into greenish yellow, yellow and reddish yellow. The tertiary hues are placed inside the area of the primary and secondary hues and in association with the parent hues. A neutral grey occupies the center of the hexagon with four radial grey patterns forming a link with the other tertiary hues. Special provision has been made for pinks which are placed adjacent to the reds but outside the hexagon. Cooperating dye and pigment manufacturers were asked to describe the hue of each of their products in accordance with this hue Indication Chart, which is contained in a pocket in Volume 4. In the Chart there is an outline diagram which records the formal descriptions associated with the individual chromatic areas. Each chromatic area is designated by an outline which functions as a line of demarcation between the different areas. Many of the chromatic areas are qualified by the terms bright and dull.

This Chart enables a reader to translate into visual terms the verbal descriptions of hue given in the *Colour Index*.

TO MANUFACTURERS OF DYESTUFFS, TEXTILE CHEMICALS, WET-PROCESSING MACHINERY, LABORATORY EQUIPMENT, AND INCIDENTALS FOR TEXTILE WET-PROCESSING PLANTS:

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OF INFORMATION CONCERNING YOUR NEW PRODUCTS THAT HAVE BEEN PLACED ON THE MARKET *SINCE NOVEMBER, 1960* . . . . .

is invited

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SPECIFICATIONS . . .

Information should include the trade name of the product and a BRIEF summary of its uses and properties. Please type (double-spaced) the information for each product on a separate sheet of paper (8½ x 11). If illustrations are necessary, glossy photos or black ink drawings should be furnished. It the trade name is registered or the product is patented and you wish these facts indicated, please so note.

DEADLINE . . .

In order to insure that your new products for wet-processing may be listed in this PROCESSING REVIEW NUMBER of December 11, information concerning them should be in our office NO LATER THAN NOVEMBER 1st. *It is important that you list only those products which have been brought out since November,* 1960. Information should be addressed to The Editor, American Dyestuff Reporter, 44 East 23rd Street, New York 10, N.Y.

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CLASSIFIED ADVERTISEMENTS

Advertisements in this section are restricted to HELP WANTED — POSITION WANTED — EQUIPMENT wanted or for sale. Rates, effective February 1, 1951; one-time, $14.00 per column inch; 13 or more times, $12.00 per column inch; Position Wanted, $4.00 per column inch. Figure 38 average words per column inch. Publisher reserves the right to reject or discontinue any classified advertisement. Replies should be addressed: Box Number ..... c/o American Dyestuff Reporter, 44 East 23rd Street, New York 10, N. Y.

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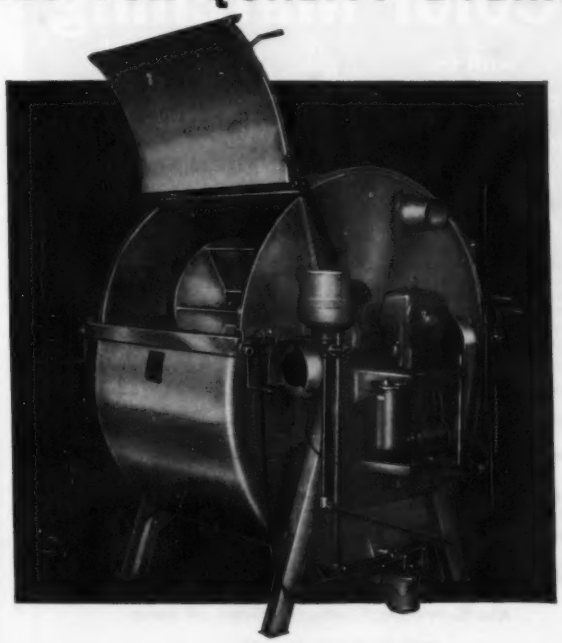

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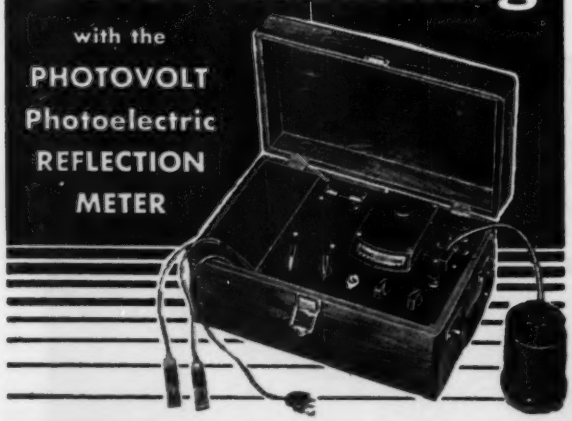

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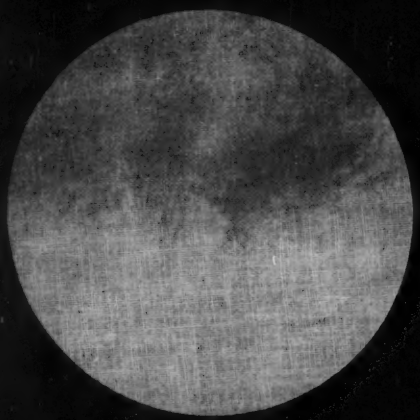

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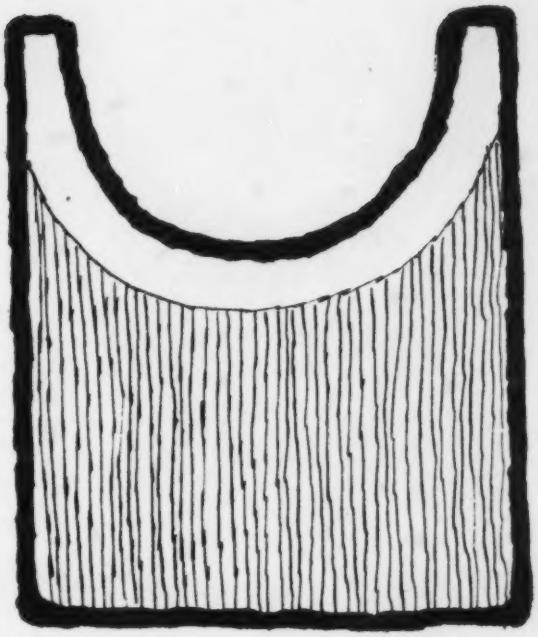

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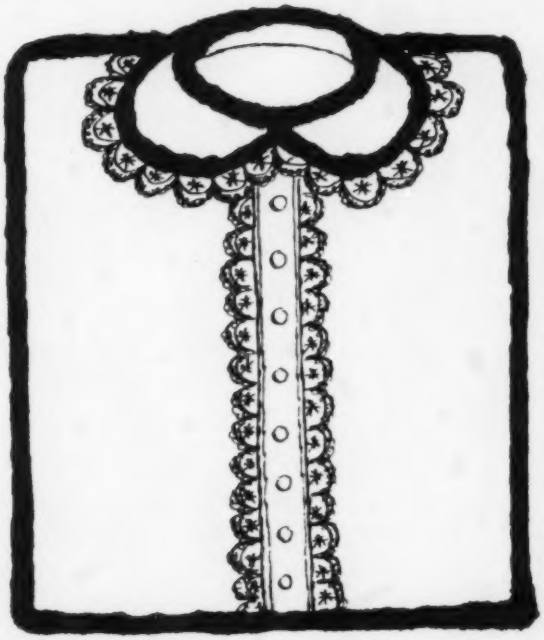

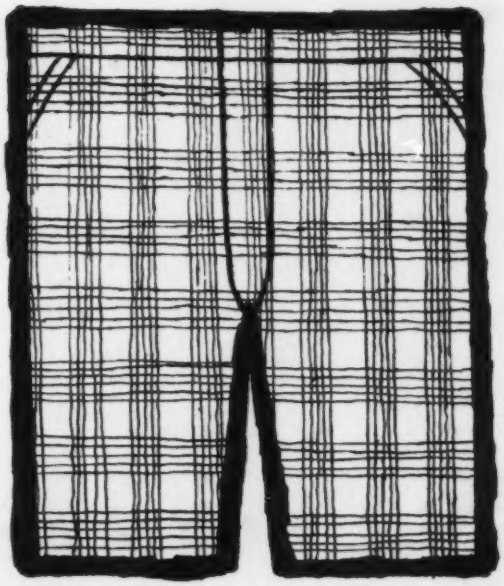

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